Management and Performance

Overview

The Management and Performance section provides a comprehensive record of the past and planned performance for NASA's programs and projects. This section includes:

- Progress on NASA's performance improvement initiatives including discussion of the High Priority Performance Goals;
- 2011 Major Program Annual Report (MPAR) Summary of the cost and schedule performance of NASA's projects with estimated life cycle cost above $250 million, including project baselines/cost estimates and confidence levels for each of these projects, and Corrective Action Plan Status Reports (for selected projects as required by section 1203 of the NASA Authorization Act of 2010); and
- FY 2011 and FY 2012 Performance Plans based on Congressional budget action.

NASA's planning and performance management processes are an essential part of the Agency's governance and strategic management system. The Agency has an integrated system to: plan strategy and implementation; monitor, assess, and evaluate performance toward commitments; identify issues; gauge programmatic and organizational health; and provide appropriate data and information to NASA decision makers.

Through its strategic management system, NASA: identifies the Agency's long-term Strategic Goals, multi-year outcomes, and other key performance measures; develops and implements plans to achieve these goals; and continuously measures the Agency's progress toward these goals. NASA managers use performance results as a basis for key investment decisions, and NASA performance data provides a foundation for both programmatic and institutional decision-making processes.

NASA's planning and performance management processes provide data to Agency management via: ongoing monthly and quarterly analysis and reviews; annual assessments in support of budget formulation (for budget guidance and issue identification, analysis, and disposition); annual reporting of performance, management issues, and financial position; periodic, in-depth program or special purpose assessments; and recurring or special assessment reports to internal and external organizations.

NASA's performance system is designed to align with the Agency's internally and externally imposed performance measurement and reporting requirements, tools, and practices, including the Government Performance and Results Act and Executive Order 13450, “Improving Government Program Performance”. Examples of recent activities are provided in the Performance Improvement narrative that follows.

This section includes the FY 2011 and FY 2012 performance commitments, NASA’s target results for the requested resources. The annual performance plans reflect the updated alignment of performance commitments with the Agency’s 2011 Strategic Plan. This section also includes a summary and crosswalk of NASA’s new performance management framework as defined in the latest Strategic Plan. Each performance plan consists of measureable long-term outcomes, near-term objectives, and annual performance goals. The updated performance management framework helps NASA better measure its progress toward achieving the strategic goals for exploration, science, and technology development. NASA uses internal and external assessments to rate progress toward the measures.

NASA continues to use independent program assessments, which are listed in the theme and program sections of this document, and commits to improvement actions in response to the findings.

NASA strives to find new ways to use performance information to support decisions concerning strategy and budget. A continued focus for NASA in FY 2011 is to improve the metrics and analysis processes for life cycle cost and schedule performance monitoring and reporting. The Major Program Annual Report discussed in this section is one of the reporting tools used to determine how NASA performs this task.

Performance Improvement

NASA's missions demand high levels of performance from our diverse workforce, whose knowledge, skills, and dedication are the backbone of our achievements. NASA has aligned the Agency's performance systems, organizational structure, policies, and processes to ensure programmatic content, institutional capabilities, and other resources are focused on successfully completing the programs and projects tied to our Strategic Goals. The Agency governance councils have joint responsibility for sustaining this alignment through a set of clear, transparent, and repeatable processes that flow to all organizational elements and levels within the Agency. Aligning the entirety of NASA with our Strategic Goals is essential for organizational effectiveness and efficiency. NASA communicates priorities and directions for all components of the Agency through a planning and decision process based on prior year performance and future year objectives. This annual guidance is the benchmark for other processes, including feedback on internal control needs, risk concerns, and safety and mission assurance issues that ripple through our programmatic and institutional framework, ultimately influencing the allocation of resources for each budget year.

The Agency continues to find value in and improve upon its monthly forum, the Baseline Performance Review. As an integrated review of institutional and program activities, interrelated issues that impact performance and program risk are highlighted and actions are assigned for resolution. The Baseline Performance Review forum fosters communication across organizational boundaries to address mutual concerns and interests.

In FY 2011, NASA is participating in an Administration pilot program for impact evaluations. NASA is participating as a way of assessing programs in NASA’s portfolio that do not fall within the space flight program management process, and tobuild additional internal capability for this type of assessment. The intent of this pilot is to compare the change in decision-making performance by partner organizations, primarily through a value-of-information or cost-benefit approach. Two key questions in this pilot evaluation are: What is the type and extent of socioeconomic benefits attributable to applications of NASA Earth science? Is the program’s underlying systems-engineering model effective at demonstrating relevance of NASA Earth science data for societal benefits?

NASA selected the Applied Sciences program as its pilot, which has conducted analyses of two projects during FY 2010 (for the Malaria Early Warning System, and the U.S. Forest Service's BlueSky Smoke Forecasting System). Several techniques were used to attempt to quantify the socioeconomic benefits and impacts of the projects. Information about the two FY 2010 impact assessments and projects scheduled for FY 2011 assessment, will be posted to the Applied Sciences program Web site when available.

In FY 2011, NASA began reporting its Corrective Action Plan Status Report in response to section 1203 of the NASA Authorization Act of 2010 (P.L. 111-267; 42 U.S.C. 18442). The report’s focus is on two key areas: 1) status of significant progress NASA made on transforming program/project management, acquisition strategies and procurements; and 2) specific action plans for projects exceeding cost and schedule thresholds as defined in the requirement.

Management and Performance

In FY 2011 and FY 2012, NASA will continue to examine its policies and processes to enhance its performance management system and use of performance information in planning and decision making.

High Priority Performance Goals (HPPGs)

In FY 2010, NASA began tracking its High Priority Performance Goals (HPPGs) developed in response to a White House initiative for building a high-performing government. NASA has identified five HPPGs with specific action plans and quarterly milestones. NASA expects to set a new education-related HPPG in the future, reflecting Administration interest in cross-agency educational priority goals that foster increased horizontal collaboration. The HPPGs are linked to NASA's Performance Plan and are included in the Annual Performance Plan. NASA's current HPPGs are listed on the new Web site http://www.performance.gov and are as follows:

1. Research and develop new technologies to increase the flexibility and efficiency of the Nation's air traffic system;

2. Study Earth from space to understand climate change, weather, and human impact on our planet;

3. Conserve valuable natural resources by reducing NASA's energy and water use;

4. Safely fly out the Space Shuttle manifest and retire the fleet; and

5. Establish an independent organization to enhance the utilization of the International Space Station as a National Laboratory.

2011 Major Program Annual Report Summary

The 2011 Major Program Annual Report (MPAR) is provided to meet the requirements of section 103 of the NASA Authorization Act of 2005 (P.L. 109-155; 42 U.S.C. 16613). The 2011 MPAR consists of this summary and FY 2012 Budget Estimates MPAR Projects in Development for the sixteen projects included in this year's report. The latter documents constitute each project's annual report, or baseline report, if this is the first year for which it is in reporting. This summary also includes the confidence level information as requested in the Conference Report accompanying the FY 2010 Consolidated Appropriations Act (P.L. 111-117).

Table 1 provides cost, schedule, and confidence level information for NASA projects currently in development with life cycle cost estimates of $250 million or more.

Changes in MPAR Composition since the 2011 NASA Budget Estimates

One project, the Solar Dynamics Observatory (SDO) mission is no longer included in this report. SDO successfully launched in February 2010 and is operational.

Three major projects with estimated life cycle costs greater than $250 million received authority to proceed into development since the 2010 MPAR was prepared for the 2011 NASA Budget Estimates. These projects have a baseline shown in this report:

- Lunar Atmosphere and Dust Environment Explorer (LADEE);
- Mars Atmosphere and Volatile EvolutioN (MAVEN); and
- Orbiting Carbon Observatory-2 (OCO-2).

Four major projects had no cost or schedule growth:

- Gravity Recovery and Interior Laboratory (GRAIL);
- Juno mission;
- Magnetospheric Multiscale mission (MMS); and
- Radiation Belt Storm Probes (RBSP);

One project James Webb Space Telescope (JWST) has reported that the baseline development cost and launch readiness date will be exceeded by more than 15 percent and 6 months.

Updated cost and schedule estimates are provided for eight projects baselined in previous MPAR reports:

- Aquarius mission;
- Glory mission;
- Global Precipitation Measurement (GPM);
- Landsat Data Continuity Mission (LDCM);
- Mars Science Laboratory (MSL);

- National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP);
- Stratospheric Observatory for Infrared Astronomy (SOFIA); and
- Tracking and Data Relay Satellite (TDRS) K&L

The Glory project baseline has been re-established, as required by the Authorization Act when the development cost estimate for a project exceeds 30% of its original baseline. This new baseline reflects previously-reported cost and schedule growth due to the change of the baseline spacecraft payload computer for Glory--from the Maxwell SCS750 single board computer to the BAE Rad750 single board computer.

Changes in Cost and Schedule Estimates from the 2010 MPAR

Two projects exceeded a cost or schedule threshold since the 2010 MPAR:

- JWST cost and schedule have grown since the baseline in 2009. The cost and schedule are under assessment at this time.
- The NPP schedule has grown by 41 months and development costs have grown by 32 percent since the project was baselined in 2006. The NASA-developed spacecraft has been completed since 2005; and the NASA-developed Advanced Technology Microwave Sounder (ATMS) and the Clouds and the Earth's Radiant Energy System (CERES) sensors have been complete and integrated onto the spacecraft since 2005 and 2008, respectively. NASA has delayed the launch of NPP to October 2011 to accommodate late delivery of the NPOESS Integrated Program Office supplied Cross-track Infrared Sounder (CrIS).

The Agency is completing the report required under the Act providing additional information on growth of the JWST mission, which includes the reasons for these changes in cost and schedule, alternatives assessed by the Agency, and the selected actions.

Confidence Levels

NASA utilizes a confidence level approach to budgeting. This approach incorporates program and project risks directly into cost and budget estimates and, as such, is suited to NASA's complex, high-risk portfolio. This approach affords project managers the necessary flexibility to pro-actively manage and mitigate the large technical and other risks associated with NASA's missions. The likelihood of meeting any given estimate is referred to as the confidence level (CL). Implementation of this approach varies depending on the type of program, as described below. NASA has included the confidence level in Table 1 below, where applicable. NASA distinguishes between Space Flight and Ground System projects in development; projects in operations, and Research and Technology projects. All of the projects that are currently subject to MPAR reporting fall within the Space Flight category.

NASA's acquisition strategy policy (NPD 1000.5) requires space flight projects and programs to develop probabilistic cost estimates for space flight projects in development, which incorporate the likely cost impacts of project risks. NASA targets a confidence level of about 70 percent for most of its projects and programs.

NASA is transitioning its probabilistic cost estimation from "cost risk only" to a joint cost and schedule approach designed to increase the likelihood of project success at the specified funding level. The application of the joint cost and schedule confidence level (JCL) approach will increase insight into risks and associated contingencies within a project's integrated technical, cost, schedule, and phasing plan.

Management and Performance

NASA started developing estimates using the JCL technique during 2010. Because this approach requires the employment of new tools and techniques, and is performed during key decision points, full implementation will take some time to deploy. Many projects whose key decision points took place earlier before 2010 had baselines established under cost estimating policies that preceded JCL.

Table 1: MPAR Summary and Confidence Levels

Project	Base Year	Confidence Level[1]	Development Cost Est. ($M)		Cost Change (%)	Key Milestone[2]	Key Milestone		Schedule Change (months)	Cost Change > 15%[3]	Schedule Change > 6 Mo[3]	Factors Contributing to Breaches since 2010 MPAR	
			Base	2011			Base	2010				Internal	External
Aquarius	2007	75%[5]	$193	$227	18	LRD	Jul-09	Jun-11	23	X	X		
Glory	2011	N/A[6]	$338	$338	0	LRD	Feb-11	Feb-11	0				
GPM	2010	70%[7]	$555	$515	-7	LRD	Jul-13	Jul-13	0				
GRAIL	2009	70%	$427	$427	0	LRD	Sep-11	Sep-11	0				
Juno	2009	70%	$742	$742	0	LRD	Aug-11	Aug-11	0				
JWST	2009	JCL in-process	$2,581	TBD	TBD	LRD	Jun-14	TBD	TBD	**X**	**X**	Cost and schedule are under assessment at this time.	
LADEE	2011	70% (JCL)	$168	$168	0	LRD	Nov-13	Nov-13	0				
LDCM[4]	2010	70% (JCL)	$583	$588	1	LRD	Jun-13	Jun-13	0				
MAVEN	2011	70% (JCL)[8]	$567	$567	0	LRD	Nov-13	Nov-13	0				
MMS[4]	2010	70% (JCL)	$857	$857	0	LRD	Mar-15	Mar-15	0				
MSL	2010	70% (JCL)	$1,720	$1,802	5	LRD	Nov-11	Nov-11	0				
NPP	2006	N/A[9]	$593	$780	32	LRD	Apr-08	Oct-11	42	**X**	**X**		Late delivery of the NPOESS IPO-supplied instrument
OCO-2	2011	70% (JCL)[10]	$249	$249	0	LRD	Feb-13	Feb-13					
RBSP	2009	70%	$534	$534	0	LRD	May-12	May-12	0				
SOFIA	2007	70% (JCL)	$920	$1,128	23	FOC	Dec-13	Dec-14	12	X	X		
TDRS-K,L[4]	2010	75%	$209	$192	-8	LRD	K Dec-12 L Dec-13	K Dec-12 L Dec-13	0				

[1]The confidence level estimates reported here reflect an evolving process as NASA improves its probabilistic estimation techniques and processes. Each estimate reflects the practices and policies at the time it was developed. For example, levels provided in Table 1 for three projects (LDCM, MMS, MSL, and SOFIA) represent a JCL. JWST has a JCL in progress. Estimates that include combined cost and schedule risks are denoted as JCL estimates; all other CLs reflect cost confidence without necessarily factoring the potential impacts of schedule changes on cost. Reported estimates can range up to 80 percent, based on techniques currently available.

[2]Key Milestone LRD = Launch Readiness Date; and FOC = Full Operational Capability.

[3]Bolded "X" indicates new changes compared to 2010 MPAR.

[4]The confidence level estimate addresses the full partnership; the development cost reflects the NASA portion of project costs.

[5]CL estimate reflects NASA portion of project; the cost increases reflected here represent the impact of partnership delays.

[6]A confidence level for the re-baselined Glory project was not part of the project's continuation (rebaseline) review.

[7] Global Precipitation Measurement – The 70% confidence level is based on analysis done by the Standing Review Board (SRB). NASA has required the project to generate a JCL and have it evaluated by the SRB. This has been done, but the results were not available as of this writing

[8]JCL included schedule risk of launch vehicle but used the HQ-provided LV cost as a pass-through number per agreement with Standing Review Board (SRB).

[9]Pre-dates use of probabilistic analysis.

[10]JCL was performed for Phases C&D, excluding project managed unallocated future expenses, JPL fees, launch services, and low-level fixed cost activities at GSFC.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Astrophysics
Program: Cosmic Origins
MPAR Project In Development: SOFIA

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**737.5**	**73.6**	**-**	**71.4**	**73.3**	**77.2**	**77.4**	**75.0**	**-**	**-**
FY 2011 Costs			79.9							
CSLE				12.8	12.2	10.8	10.6	11.0	210.4	
Administrative Labor Adjustments		1.3								
2011 MPAR Project Cost Estimate	**737.5**	**74.9**	**79.9**	**84.2**	**85.5**	**88.0**	**88.0**	**86.0**	**1679.0**	**3002.9**
Formulation	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0
Development	702.5	74.9	79.9	84.2	85.5	88.0	13.5	0.0	0.0	1128.4
Operations	0.0	0.0	0.0	0.0	0.0	0.0	74.5	86.0	1679	1839.5

Note:

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C. .*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

Additional funds were added to the development budget to preserve the new instrument selection schedule and science hours and to fund risk reduction activities. The operations budget was decreased due to risk reduction activities previously planned for operations being moved into development. The SOFIA milestone Full Operational Capability FOC has been redefined as the capability to provide full science operational capability with four available instruments. Outyear budgets reflect NASA's intention to increase the efficiency of the science operations after FOC has been achieved.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Astrophysics
Program:	Cosmic Origins
MPAR Project In Development:	SOFIA

Project Purpose

NASA is developing SOFIA as a world-class airborne observatory that will complement the Hubble, Spitzer, Herschel and James Webb space telescopes, and major Earth-based telescopes. SOFIA features a German-built 2.5-meter (100-inch) diameter far-infrared telescope weighing 20 tons, and mounted in the rear fuselage of a highly modified Boeing 747SP aircraft.

The SOFIA mission will study many different kinds of astronomical objects and phenomena, including: star birth and death, formation of new solar systems, identification of complex molecules in space, planets, comets and asteroids in this solar system, nebulae and dust in galaxies (i.e., ecosystems of galaxies), and black holes at the center of galaxies. The infrared light of these objects is only partially visible from the ground due to water vapor in Earth's atmosphere. However, at high altitudes, the influence of water vapor is negligible, allowing better observation of these astronomical objects.

SOFIA'S reflecting telescope provides astronomers with access to the visible, infrared and sub-millimeter spectrum, with optimized performance in the mid-infrared to sub-millimeter range. During its 20-year expected lifetime, SOFIA will be capable of enabling "Great Observatory" class astronomical science.

SOFIA will be NASA's only far-infrared mission, as Spitzer cryogens have been depleted and Herschel's cryogens will be exhausted by 2013. It is the only mid-infrared mission until JWST becomes operational. SOFIA's ability to reconfigure and flexibility ensures the integration of cutting-edge technology and the ability to address emerging scientific questions. For more information, please see http://www.nasa.gov/mission_pages/SOFIA/index.html.

Project Parameters

SOFIA was designed as a highly modified Boeing 747SP aircraft with a large open-port cavity aft of the wings, housing a 2.5-meter telescope optimized for infrared and sub-millimeter wavelength astronomy. SOFIA will operate in flight at 41,000 feet, and at FOC will have four instruments, with additional instruments available after FOC. SOFIA will ramp up to 960 science hours per year, and flights will last six to eight hours on average.

Germany has provided the telescope assembly and assists with mission operations. NASA has provided, refurbished, and modified the airplane, and provides the Science Operations Center.

The U.S.-developed instruments include High-speed Imaging Photometer for Occultation (HIPO), First Light Infrared Test Experiment CAMera (FLITECAM), Faint Object InfrRed CAmera for the SOFIA Telescope (FORCAST), Echelon-Cross-Echelle Spectrograph (EXES), and High-resolution Airborne Wideband Camera (HAWC). The two German instruments are the German Receiver for Astronomy at Terahetz Frequencies (GREAT) and Field Imaging Far-Infrared Line Spectrometer (FIFI LS).

Technology investments for possible future SOFIA instrumentation are made through the Cosmic Origins Supporting Research and Technology program.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Astrophysics
Program: Cosmic Origins
MPAR Project In Development: SOFIA

Project Commitments

SOFIA initiated science observations in December 2011 with the FORCAST instrument. Designed to work for 20 years, SOFIA will reach FOC as an airborne observatory in December 2014.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Platform DFRC/L3/MPC		Refurbished Boeing 747SP modified to accommodate telescope	Same Same	
Science Operations Center	ARC/USRA	Science Operations Center will schedule observations, and manage data acquisition and processing	Same Same	
Telescope	Germany (DLR)	2.5m diameter, dual mirror	Same	Same
Flight Operations	DFRC/CSC DyneCorp	Flight crew, maintenance, and fuel	Same Same	
HIPO Lo	well Observatory	Simultaneous high-speed time-resolved imaging photometry at two optical wavelengths	Same Same	
FLITECAM UCLA		Large field-of-view, narrow- and broad-band photometric imaging and low-resolution spectroscopy from 1 to 5.5 μm	Same Same	
FORCAST Corn	ell University	Large field-of-view, narrow- and broad-band photometric imaging and moderate-resolution spectroscopy from 4 to 42 μm	Same Same	
EXES ARC		Echelon Spectrometer, 5-28 microns R=105, 104, or 3000	Same Same	
HAWC Univers	ity of Chicago	Far-Infrared Bolometer Camera, 50-240 microns	Same Same	
GREAT Germany	(DLR)	Infrared heterodyne spectrometer, 60-200 microns	Same Same	
FIFI LS	Germany (DLR)	Imaging spectrometer, 42-210 microns	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Astrophysics
Program: Cosmic Origins
MPAR Project In Development: SOFIA

Schedule Commitments

The development and test plan has been modified to enable earlier science observations by the science community, making it concurrent with the late phases of aircraft flight testing. Initial science observations with a subset of science instruments began in December 2011. Completion of the remaining science instruments and refinement of telescope performance will enable FOC in December 2014.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
First Flight	2000	2007	2007
First Science (Early Science)	N/A	2010	2011
FOC	N/A	2014	2014

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Stratospheric Observatory for Infrared Astronomy (SOFIA)	2007	919.5	2011	$1,128.4	23	FOC	12/2013	12/2014	12

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**919.5**	**1,128.4**	**208.9**
Aircraft/Spacecraft	657.7	762.0	104.3
Other Costs	62.2	139.9	77.5
Science/Technology	199.6	226.5	26.9

Project Management

The overall SOFIA project and SOFIA airborne system are managed by Dryden Flight Research Center (DFRC). SOFIA science is managed by Ames Research Center (ARC).

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Astrophysics
Program: Cosmic Origins
MPAR Project In Development: SOFIA

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Platform	DFRC	DFRC	Germany - DLR/DSI
Science	ARC	None	Germany - DLR/DSI
Mission Operations and Data Analysis	ARC	None	Germany - DLR/DSI
Instruments ARC		None	Germany - DLR/DSI

Acquisition Strategy

DFRC manages the program and the platform project (airframe and telescope). DFRC is working with L-3 Communications (Waco, Texas), and MPC Products Corporation (Skokie, Illinois) to support the completion of the development, integration, and test of the airborne platform system. L-3 modified the Boeing 747SP aircraft to install the telescope provided by Germany (DLR/DSI). MPC is developing the telescope cavity door drive system. DFRC is also working with CSC DynCorp (El Segundo, California) to provide aircraft maintenance support.

ARC manages the science project. ARC is working with University Space Research Association (USRA) (Columbia, Maryland) for the SOFIA science planning, ground science facilities, science instrument and technology development, and education and public outreach.

Second generation and later instruments will be solicited through an open competition using a NASA Announcement of Opportunity.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Standing Review Board	4/2010	Early science project review. The board determined that plan for early science had merit.	4/2012

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Loss of science community and DLR support due to late science	Loss of science community support due to delays in science continues to be a concern.	Report program accomplishments as they occur to keep the science community engaged and supportive. Reaction to recent program successes, including the first light accomplishment, has been very positive.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Astrophysics
Program:	Cosmic Origins
MPAR Project In Development:	SOFIA

Corrective Action Plan (as submitted in Report on Program and Cost Assessment January 11, 2011 – as required under 1203)

Project Description: The Stratospheric Observatory for Infrared Astronomy (SOFIA) is an airborne observatory that will study the universe in the infrared (IR) spectrum. These IR observations allow scientists to study the dust between stars, the formation of stars and new solar systems, the chemistry of the universe, and the deep universe where the most distance galaxies are seen in IR light. SOFIA will host a complement of scientists, computer engineers, graduate students, and educators on night-long research missions. SOFIA will be a major factor in the development of observational techniques and of new instrumentation and in the education of young scientists and teachers in the discipline of IR astronomy.

NASA and the Deutches Zentrum für Luft- und Raumfahrt (DLR), Germany's Aerospace Research Center and Space Agency, are working together to construct SOFIA, a Boeing 747SP aircraft which was modified by L-3 Communications Integrated Systems to accommodate a 2.5 meter reflecting telescope. SOFIA will be the largest airborne observatory in the world and will make observations that are impossible for even the largest and highest of ground-based telescopes. SOFIA will operate at 41,000 feet using U.S. and German instruments and flights will last, on average, 6 to 8 hours.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Astrophysics**
Program:	**Cosmic Origins**
MPAR Project In Development:	**SOFIA**

CORRECTIVE ACTION PLAN SUMMARY

2010 ISSUES	CORRECTIVE ACTION PLAN
ISSUE 1: Definition of Full Operational Capability (FOC) Milestone Requirements **CURRENT STATUS:** The Full Operational Capability (FOC) milestone requirements have been revised to emphasize science instrument observational capability (4 science instruments), the overall program has been replanned in terms of schedule (no change in FOC date, however), and the NASA Agency Program Management Council has approved the replan.	Programmatic – Review of the definition of the Full Operational Capability (FOC) milestone technical requirements by the independent Standing Review Board (SRB) resulted in a finding by the SRB that the original definition (800 flight hours per year) was an improper definition in that insufficient science emphasis was contained in the definition. Therefore, the definition of FOC was revised to focus on science instrument capability (the requirement was revised to 4 available science instruments, consistent with the MPAR definition), and the overall program was replanned around that definition. The replanned program plan was approved by the NASA Agency Program Management Council (APMC) on October 6, 2010. This did not cause a change in the externally-committed FOC date of December 2014, but does emphasize science in the definition.
ISSUE 2: Late delivery of Cavity Door Drive System **CURRENT STATUS:** The cavity door drive system controller and actuator was delivered and integrated in the SOFIA observatory, and flight testing to clear the full flight envelope has been completed. This permits the continuation of SOFIA system testing, leading up to the first science flights in December 2010.	Programmatic – Late delivery of software that operates the telescope observation doors on the aircraft resulted in later-than-planned initiation of open door flight testing and science observation. NASA stationed representatives at Woodward's facility to support and oversee the vendor until delivery of the cavity controller and actuator.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: Glory

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**356.4**	**31.8**	**-**	**5.3**	**3.8**	**6.1**	**5.9**	**6.0**	**-**	**-**
FY 2011 Costs			22.2							
CSLE				0.5	0.5	0.3				
Administrative Labor Adjustments		0.4								
Extended Ops Budget not included in LCC						-3.1	-5.9	-6.0		
2011 MPAR Project Cost Estimate	**356.4**	**32.2**	**22.2**	**5.8**	**4.3**	**3.3**	**0.0**	**0.0**	**0.0**	**424.1**
Formulation	70.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.8
Development	285.6	32.2	19.8	0.0	0.0	0.0	0.0	0.0	0.0	337.6
Operations	0.0	0.0	2.4	5.8	4.3	3.3	0.0	0.0	0.0	15.8

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*
- *The row titled "Extended Ops Budget not included in LCC" reflects budgeted funds for operations that continue beyond the period of prime operations for which the project was baselined.*

Explanation of Project Changes

In spring 2009, a problem with the Maxwell-supplied spacecraft computer had emerged and NASA changed the baseline Maxwell computer to a BAE Rad750 Single Board Computer, delaying the Glory launch readiness date to November 2010. By May 2010, the BAE unit was delivered and successfully integrated to the Glory Observatory.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
MPAR Project In Development:	Glory

The November 2010 LRD was replanned for February 2011 to allow for completion of the Taurus XL launch vehicle's Return to Flight activities, further risk reduction related to spacecraft subsystems, and resolution of launch range manifest conflicts with other scheduled launches. The approved life cycle cost remained the same and costs associated with the LRD change were covered within the project's existing cost reserves.

The mission was also impacted by the repair of a Solar Array Drive Assembly. In August 2010, an inspection revealed excessive wear to its slip ring assembly and it was deemed not flight-worthy. By November 2010, the SADA was repaired, tested, and successfully integrated to the Glory observatory. The November 2010 LRD was changed to February 23, 2011.

The risk associated with the readiness of the Taurus XL launch vehicle was retired following conclusion of the Mishap Investigation Board (MIB) that reviewed the failure of the Taurus XL fairing system, which resulted in the loss of the Orbiting Carbon Observatory. NASA developed a corrective action plan that incorporated the Mishap Investigation Board recommendations. Once all corrective actions had been closed out, NASA's Flight Planning Board approved the Taurus XL for Return to Flight. By this time, however, the LRD was delayed. The new LRD of February 23, 2011, accommodated this delay concurrent with the spacecraft's solar array drive assembly recovery.

Project Purpose

The Glory mission will contribute to NASA's research on atmospheric conditions that influence climate and will improve understanding of the natural and human-made factors that contribute to climate change. It will also enable a greater understanding of the seasonal variability of aerosol properties. Both advances are essential components of predicting climate change. Aerosols interact with atmospheric conditions in complex ways that can have large effects on climate.

The mission will also provide precision measurements of the solar irradiance; solar radiation is the dominant, direct energy input into the terrestrial ecosystem, affecting all physical, chemical, and biological processes.

Glory's science objectives are specifically to:

1) Determine the global distribution, microphysical properties, and chemical composition of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the aerosol direct and indirect effects on climate; and

2) Continue measurement of the total solar irradiance to determine the Sun's direct and indirect effect on Earth's climate.

For more on the scientific questions addressed by Glory, visit http://glory.gsfc.nasa.gov/.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
MPAR Project In Development:	Glory

Project Parameters

The Glory mission will operate two scientific instruments aboard a modified, preexisting NASA spacecraft. It will fly in NASA's low Earth orbit Afternoon, or A-Train, constellation to enhance the utility of the mission data through synergistic observations from the other satellites. The A-Train constellation currently includes five spacecraft flying in close temporal proximity to each other. The Glory spacecraft will be the sixth satellite in the A-Train when it joins the constellation in FY 2011.

The APS is an advanced polarimeter that will provide measurements to increase our understanding of black carbon soot and other aerosols as causes of climate change. The APS will provide unprecedented measurements of the global distribution of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the direct and indirect effects of aerosols on climate. The APS was developed by Raytheon Space and Airborne Systems in El Segundo, CA. As of March 2009, the APS was delivered and successfully integrated to the Glory Observatory.

The TIM instrument provides continuity for the 31-year solar irradiance data record by extending the measurement currently provided by (SORCE. University of Colorado's Laboratory for Atmospheric and Space Physics is developing the TIM sensor, the instrument's Sun pointing platform, and the TIM science operations center.

Orbital Science Corporation in Dulles, VA, is developing the spacecraft and the ground system/mission operations center, and integrated the instruments. Orbital also provides mission systems engineering support and performs mission operations.

Kennedy Space Center is responsible for Glory launch services. The mission will launch on a Taurus XL from Vandenberg Air Force Base, CA.

Project Commitments

Glory will launch in February 2011 to begin a three-year prime mission (with a five-year goal) to gather scientific measurements of atmospheric aerosols and solar irradiance.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
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Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
APS	Raytheon	Provide unprecedented measurements of the global distribution of natural and anthropogenic aerosols	Same	Same
TIM	U of Colorado LASP	Maintain an uninterrupted solar irradiance data record	Same	Same
Spacecraft	Orbital	Refurbishment of the Vegetation Canopy Lidar (VCL) mission bus	Same	Same
Launch vehicle	Orbital	Taurus XL	Same	Same
Ground System Ops, TIM Science Ops, APS Science Ops	Orbital / Colorado University-Boulder LASP /GSFC Institute for Space Studies	Combination of the commercial ground stations and the networks that connect them	APS: full data processing for 1 yr w/ 2 addt'l yrs of archiving. TIM: full data processing for 3 yrs	Same
Mission Ops	Orbital	Operations of the spacecraft and the generation of command uplink	Same	Same
Data Archive	GSFC Earth Science Distributed Active Archive Center (GES DAAC)	Archival and distribution of mission data	Same	Same

Schedule Commitments

Glory was confirmed for development on December 13, 2005.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Mission Confirmation Review	12/2005	12/2005	12/2005
Mission Pre-ship review	8/2008	7/2010	12/2010
Launch	12/2008	11/2010	2/2011

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
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Development Cost and Schedule Summary

Project	Base Year	Base Year Adjusted* Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Glory	2011	337.6	2011	337.6	0	Launch Readiness	02/2011	02/2011	0

*Base year adjusted to current accounting.

Development Cost Details

Element	Base Year Adjusted Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**337.6**	**337.6**	**0**
Spacecraft	59.8	59.8	0
Payload	128.2	128.2	0
System I&T	4.6	4.6	0
Launch Vehicle	64.1	64.1	0
Ground System	1.3	1.3	0
Science/Technology	14.9	14.9	0
Other	64.7	64.7	0

Project Management

Goddard Space Flight Center has project management responsibility. The Science Mission Directorate Program Management Council has program oversight responsibility.

The Earth Science Division Director is the responsible official for this project.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
APS	GSFC	GSFC	None
TIM	GSFC	GSFC	None

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**Glory**

Acquisition Strategy

All major procurements for the directed Glory mission were sole-source awarded to meet the objective for an accelerated mission:

Aerosol Polarimetry Sensor: Raytheon Space and Airborne Systems;

Total Irradiance Monitor: University of Colorado Laboratory for Atmospheric and Space Physics; and

Spacecraft/spacecraft support: Orbital Science Corporation.

There are no remaining major procurements, as all instrument and spacecraft contracts are in place.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance NASA	HQ	N/A	Mission Readiness Review (MRR) - Final pre-flight review of the operational readiness of the mission	02/2011
Performance NASA	HQ	N/A	Launch Readiness Review (LRR) - Final pre-launch review of the launch vehicle readiness	02/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Launch Services Impact of Taurus XL Launch Failure on Glory	If Taurus T-8 (used on OCO mission) launch failure findings and / or corrective actions impact T-9 (Glory) schedule, then the Glory LRD will be impacted.	In October 2010, NASA's Flight Planning Board approved the closure of the KSC/Launch Services program's Return to Flight activities. At this point, the Return to Flight activities had impacted the November 22, 2010 launch readiness date by two months. The new LRD of February 22, 2011, accommodated this delay concurrent with the spacecraft's SADA recovery.

Corrective Action Plan (as submitted in Report on Program and Cost Assessment January 11, 2011 – as required under 1203)

Project Description: Sunlight is the dominant direct energy input into the Earth's climate system, affecting all physical, chemical, and biological processes. Thus, it is critical to monitor solar output and measure aerosols that affect Earth's energy budget in complex ways that can have large effects on climate. The Glory mission will contribute to NASA's Earth science research effort by improving our understanding of atmospheric composition and solar irradiance as they relate to Earth's energy budget. These measurements will improve understanding of the natural and man-made factors that contribute

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to climate change. Specifically, the Glory mission will measure the geographical and temporal distribution of atmospheric aerosols, small airborne particles. In addition, Glory will make highly accurate and precise measurements of solar radiation. The Glory prime mission life requirement is for three years of operations, with a goal of five years. The instruments will operate continuously while on orbit.

Glory's science objectives are to: (1) determine the global distribution, microphysical properties, and chemical composition of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the aerosol direct and indirect effects on climate; and (2) measure the total solar irradiance to determine the Sun's direct and indirect effect on Earth's climate.

The Glory mission consists of two scientific instruments—the Aerosol Polarimetry Sensor (APS) and the solar Total Irradiance Monitor (TIM)—aboard a dedicated NASA spacecraft. The following is a description of each instrument:
The APS is an advanced polarimeter used for measurements that will increase our understanding of black carbon soot and other aerosols as causes of climate change. The APS will provide unprecedented measurements of the global distribution of natural and anthropogenic aerosols and clouds with accuracy and coverage sufficient for a reliable quantification of the aerosol direct and indirect effects on climate. The second instrument, the TIM, provides measurement continuity for the more than 30-year solar irradiance data record by extending the measurement currently provided by NASA's Solar Radiation and Climate Experiment (SORCE).''

The Glory satellite will fly in the low Earth orbit A-Train constellation (multiple spacecraft flying in close proximity to provide detailed observations of the Earth system) to assess the effectiveness of combining aerosol data with data from multiple instruments for enhanced scientific value.

The Glory project will respond to the Intergovernmental Panel on Climate Change (IPCC), and the prior Climate Change Science Program (CCSP), by continuing and improving upon NASA's research of the forcings influencing climate change in the atmosphere. The scientific knowledge provided by this project will be essential to predicting future climate change and making sound, scientifically-based economic and policy decisions related to environmental change.

CORRECTIVE ACTION PLAN SUMMARY

ISSUE	CORRECTIVE ACTION PLAN
ISSUE 1: Late delivery of the Aerosol Polarimetry Sensor (APS) instrument due to technical issues and the move to a new facility at the development contractor. The APS was delivered two months later than planned in the April 2008 rebaseline.	Programmatic – In 2007, the APS development contractor, Raytheon Space and Airborne Systems (RSAS), closed the facility where the instrument was being designed and built, relocating all the development activities to a different RSAS facility. The APS

MPAR BASELINE & COST ESTIMATES

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ISSUE	CORRECTIVE ACTION PLAN
CURRENT STATUS: As of March 2009, the APS was delivered and successfully integrated to the Glory Observatory.	development contractor experienced high turnover in the project's management and technical staff over this period, and was able to retain only a small fraction of the existing instrument development team as a consequence of the move. The project worked with RSAS to get them back on track by adding management and technical expertise to the instrument development and providing continuous rotational onsite NASA presence at the APS contractor plant. Technical – Due to challenges in the instrument engineering activities, the project added management and technical expertise to the instrument development team at RSAS to facilitate rapid decision-making on technical issues related to the APS instrument and potential related impacts to the Glory observatory. This included providing continuous rotational onsite NASA presence at the APS contractor plant. Additional component-level risk mitigation testing was conducted at NASA's Goddard Space Flight Center. Schedule – As part of the cost mitigation strategy, NASA optimized the mission-level schedule and manpower to allow for the late delivery of the APS. NASA also facilitated the procurement/provisioning of schedule-critical parts.
ISSUE 2: The Glory Project was impacted by the unreliable low production yield of the Maxwell Single Board Computer (SBC). **CURRENT STATUS:** In June 2009, the decision was made to rebaseline the Maxwell SBC with a BAE RAD750. This rebaseline decision drove the launch slip from June 2009 to November 2010 and the associated cost increases.	Programmatic – Development and flight of the Maxwell SBC was originally planned to occur on the NPOESS mission and the Glory mission was to capitalize on the NPOESS SBC development efforts. After delays associated with the NPOESS mission, this removed all opportunities for Glory to benefit from any NPOESS SBC development. The Glory Project adopted completion of the development efforts associated for the Maxwell SBC. By June 2009, due to production issues that led to an unreliable yield, a decision was made to rebaseline the

MPAR BASELINE & COST ESTIMATES

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	Maxwell SBC to the BAE RAD 750. Cost - The cost for the slip in launch readiness is reflected in the current estimate provided in this report. The Glory project reduced the cost impact (also technical and schedule risks) associated with continuing to improve the unreliable low production yield by rebaselining the SBC to a BAE RAD750, executing risk-mitigation activities, and incorporating the necessary regression testing in the observatory integration and test schedule. Schedule - Glory Integration and Test schedule was reworked to accommodate the late delivery of the BAE RAD 750 Payload Interface Processor (PIP). NASA worked closely with the Glory Project and Earth Systematic Missions Program Office to monitor the development and delivery status. Additionally, the June 2009 launch readiness date was moved 17 months to November 22, 2010.
ISSUE 3: The Glory mission was impacted by the required closure of the Taurus XL launch vehicle's Return to Flight activities following the loss of the Orbiting Carbon Observatory. **CURRENT STATUS:** In October 2010, NASA's Flight Planning Board approved the closure of the KSC/Launch Services	Programmatic –Following conclusion of the Mishap Investigation Board (MIB) that reviewed the loss of the Orbiting Carbon Observatory due to failure of the Taurus XL fairing system, NASA developed a corrective action plan with 19 corrective actions. On August 10, 2010, NASA convened a meeting to review and confirm closure of corrective actions up to that time and closed out 14 of the 19 corrective actions at that meeting. All remaining test activities required for the Taurus XL to return to flight

MPAR BASELINE & COST ESTIMATES

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ISSUE	CORRECTIVE ACTION PLAN
Program's Return to Flight activities.	were completed in September, and in October 2010, NASA's Flight Planning Board approved the Taurus XL for Return to Flight. At this point, however, the Return to Flight activities necessitated a delay from the November 22, 2010 launch readiness date. The new LRD of February 22, 2011, accommodated this delay as well as the delay caused by Issue 4.
ISSUE 4: The Glory mission was impacted by the repair of the –X Solar Array Drive Assembly (SADA). In August 2010, a previous anomaly led to an inspection of the –X SADA and revealed excessive wear to the Slip Ring Assembly (SRA). As a result, the –X SADA was deemed not worthy for flight. **CURRENT STATUS:** As of Nov. 14, 2010, the –X SADA was repaired, tested, and delivered and successfully integrated to the Glory Observatory.	Programmatic – By late August 2010, the –X SADA was deemed not worthy for flight. The September 2010 –X SADA Recovery Plan included impacts to launch readiness. Cost - The Glory project reduced the cost impact associated with a full replacement of the –X SADA by procuring an Slip Ring Assembly (SRA) replacement for the –X SADA that was successfully designed, built, and tested for the Glory mission requirements. Schedule – The –X SADA SRA replacement was delivered 1 week earlier than planned. To mitigate schedule risk, the Glory Project conducted several technical reviews and pursued 3 parallel options. Upon the successful testing and delivery of a –X SRA replacement, the other 2 options were terminated. NASA's Science Mission Directorate worked closely with the Glory Project and Earth Systematic Missions Program Office to monitor the –X SADA SRA development and delivery status. The November 2010 launch readiness date was moved 3 months to February 23, 2011.

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2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**631.2**	**82.1**	**-**	**13.7**	**6.4**	**6.3**	**6.0**	**5.5**	**-**	**-**
FY 2011 Costs			106.6							
CSLE				2.5	0.9	0.9	0.9	0.9		
Administrative Labor Adjustments		0.5								
2011 MPAR Project Cost Estimate	**631.2**	**82.6**	**106.6**	**16.1**	**7.3**	**7.2**	**6.9**	**6.4**	**0.0**	**864.3**
Formulation	47.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.1
Development	584.1	82.6	106.6	6.8	0.0	0.0	0.0	0.0	0.0	780.1
Operations	0.0	0.0	0.0	9.3	7.3	7.2	6.9	6.4	0.0	37.1

Explanation of Project Changes

The changes to the NPP budget are due to the launch delay from September 2011 until October 2011 caused by late delivery to NASA of the VIIRS instrument and CrIS by the NPOESS Integrated Program Office.

Project Purpose

NPP is a joint mission with NOAA and the U.S. Air Force to extend key environmental measurements for weather prediction and research. The satellite will measure atmospheric and sea surface temperatures, humidity profiles, land and ocean biological productivity, cloud and aerosol properties, and earth radiation budget quantities.

The NPP mission has two objectives: Provide a continuation of select global change observations following the Earth Observing System missions Terra and Aqua; and provide the Nation's operational meteorological satellite system with risk-reduction demonstration and validation for critical sensors, algorithms, and ground processing. Due to NPOESS program delays propagated to the successor Joint Polar Satellite System (JPSS; see "Project Management") program, NPP data will be used operationally to avoid gaps in operational weather data.

For more information, please visit: http://jointmission.gsfc.nasa.gov.

MPAR BASELINE & COST ESTIMATES

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MPAR Project In Development: NPP

Project Parameters

The NPP spacecraft is based on a modified Ball Commercial Platform 2000 bus with a five-year design life. The NPP orbit is a polar, Sun-synchronous orbit at a nominal altitude of 824 kilometers. Four of the instruments are newly developed sensors based on heritage NASA sensors. The ATMS has been developed by NASA, and three of the instruments (VIIRS, CrIS, and OMPS) were developed by the NPOESS Integrated Program Office (IPO). A fifth sensor, CERES was a spare sensor developed by NASA for the EOS Program.

Project Commitments

NPP is being managed for a target launch in October 2011 and will undertake the following scientific measurements over its five-year operating life: atmospheric and sea surface temperatures, humidity soundings, land and ocean biological productivity, cloud and aerosol properties, and Earth radiation budget measurements. NASA's commitment is for an LRD of February 2012 including an additional $35 million mission development costs. The commitment launch readiness date, lifecycle cost, and development cost reflect residual uncertainty with the NPP partner-provided instruments and the ground system development. The commitment LRD considers as well the effects of the crowded launch manifest in late 2011, should an LRD slip be required. Funds will not be reprogrammed unless the actual launch date slips beyond the internal date.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
VIIRS	Raytheon SBRS	Provide global imagery in visible and infrared frequency bands: 0.3 to 14 microns / 400 m resolution.	Same Same	
OMPS	Ball Aerospace	Collection of total column and vertical profile ozone data with 300-380 nm / LIMB 290-1000 nm .	Same Same	
CrIS	ITT Aerospace	Temperature and moisture profiles at 3.9-15.4 microns.	Same Same	
ATMS	NG Electronic Systems	Temperature and moisture profiles at 22 channels / 23-183 ghz.	Same Same	
CERES	NG Space Technology	Provide Earth radiation budget measurements in shortwave (0.3-5micron) and longwave (8-12 micron) bands	Same Same	
Spacecraft	Ball Aerospace	5-year design life, mass is 2228 kg, Power 1400 watts.	Same Same	

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Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
CERES	NG Space Technology	Provide Earth radiation budget measurements in shortwave (0.3-5micron) and longwave (8-12 micron) bands	Same	Same
Spacecraft	Ball Aerospace	5-year design life, mass is 2228 kg, Power 1400 watts.	Same	Same
Launch vehicle	Boeing	Delta II 7920.	Same	Same
Ground system	Raytheon	Command, Control, and Communication Segment (C3S) and Interface Data Processing Segment (IDPS).	Same	Same

Schedule Commitments

The NPP mission completed Mission Confirmation Review (MCR) in November 2003.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
CrIS Flight Model Delivery	Oct 2005	June 2010	Same
ATMS Flight Model Delivery	Apr 2005	Oct 2005	Same
OMPS Flight Model Delivery	Sep 2005	Aug 2008	Same
VIIRS Flight Model Delivery	Nov 2005	Dec 2009	Same
CERES Flight Model Delivery	N/A	Oct 2008	Same
Operations Readiness Review	Jun 2006	Apr 2011	Same
Launch	Oct 2006	Sep 2011	Oct 2011

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
NPOESS Preparatory Project (NPP)	2006	592.9	2011	780.1	32	Launch Readiness	04/2008	10/2011	42

MPAR BASELINE & COST ESTIMATES

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MPAR Project In Development: NPP

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**592.9**	**780.1**	**187.2**
Aircraft/Spacecraft	160.0	209.4	49.4
Payloads	194.2	220.1	25.9
Launch Vehicle/Services	72.9	90.4	17.5
Ground Systems	48.2	75.9	27.7
Other Direct Project Cost	117.6	163.4	45.8
Science/Technology	0.0	20.9	20.9

Project Management

GSFC is responsible for NPP project management. Agency PMC has program oversight responsibility. NOAA/DOD IPO is responsible for managing development of OMPS, CrIS, and VIIRS instruments. Responsible official is the Earth Science Division Director.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Spacecraft	GSFC	None	None
ATMS Development	GSFC	None	None
OMPS Development	NPOESS-IPO	None	NOAA / DoD (NPOESS-IPO)
CrIS Development	NPOESS-IPO	None	NOAA / DoD (NPOESS-IPO)
VIIRS Development	NPOESS-IPO	None	NOAA / DoD (NPOESS-IPO)
CERES Refurbishment	GSFC	LaRC	NOAA
Data archive and storage	GSFC	None	NOAA
Ground Systems and Ops	NPOESS-IPO	None	NOAA

MPAR BASELINE & COST ESTIMATES	
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Acquisition Strategy

Spacecraft, ATMS, and CERES were procured competitively. The VIIRS, OMPS, and CrIS were procured competitively via the NPOESS Integrated Program Office.

The procurement award for each element was as follows:
- Ball Aerospace: Spacecraft and OMPS Development;
- NG Electronic Systems: ATMS Development;
- ITT Aerospace: CrIS Development;
- Raytheon: VIIRS Development;
- NG Space Technology: CERES; and
- Raytheon: Ground systems and operations.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance NPP	IRT	N/A	Operations Readiness Review	4/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Command, Control, and Communcation Segment (C3S) Ground System Development Delay	If the C3S is not ready to support satellite testing, a launch delay may result.	Coordinate closely with partner (NOAA) to ensure all necessary resources are applied to complete C3S development in parallel with satellite testing.

Corrective Action Plan (as submitted in Report on Program and Cost Assessment January 11, 2011 – as required under 1203)

Project Description: The NPOESS Preparatory Project (NPP) is a joint mission with the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Air Force (USAF) to extend key environmental measurements. The satellite will provide ozone measurements, atmospheric and sea surface temperatures, humidity sounding, land and ocean biological productivity, cloud and aerosol properties, and Earth radiation budget measurements.

The NPP project will: provide a continuation of global change observations following the Earth Observing System missions Terra, Aqua, and Aura specifically, atmospheric and sea surface

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temperatures, humidity sounding, land and ocean biological productivity, cloud and aerosol properties and Earth radiation budget measurements; and provide the Joint Polar Satellite System (JPSS) (previously the National Polar-orbiting Operational Environmental Satellite System (NPOESS)) with risk-reduction demonstration and validation for the critical JPSS/NPOESS sensors, algorithms, and processing.

The environmental data records (EDRs) scheduled to be produced by the interface data processing segment (IDPS) from the NPP data are: sea-surface temperature; vegetation index; ocean color; imagery; atmospheric temperature; moisture and pressure profiles; clear column radiances; aerosol optical thickness and particle size; surface albedo; land surface temperature; ice surface temperature; surface heat flux; cloud base height; cover and layers; cloud top temperature; height; cloud effective particle size and optical thickness; precipitable water; surface wetness; active fire detection; sea ice characterization; snow cover; suspended atmospheric matter; and surface type. Separate from the IDPS processing system, NPP data from the Clouds and the Earth's Radiant Energy System (CERES) instrument will be processed to produce solar-reflected and Earth-emitted radiation products.

The following describes the instruments that will provide these measurements:

- The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument is a multi-spectral scanning radiometer with a 3000 km swath width and derives its heritage from Advanced Very High Resolution Radiometer (AVHRR), Operational Linescan System (OLS), Moderate Resolution Imaging Spectroradiometer (MODIS), and Sea-viewing Wide Field-of-view Sensor (SeaWIFS).
- The Cross-Track Infrared Sounder (CrIS) instrument is a Michelson interferometer. Its heritage is the High Resolution Infrared Radiation Sounder (HIRS), the Advanced Infrared Sounder (AIRS), and the Infrared Atmospheric Sounding Interferometer (IASI). It will produce daily global sets of high-resolution temperature and moisture profiles for scenes with less than 50 percent cloud cover. It is co-registered with the Advanced Technology Microwave Sounder (ATMS) and is designed to work in conjunction with it.
- The ATMS instrument is a passive microwave radiometer with a swath width of 2300 km. Its heritage is the Advance Microwave Sounding Unit (AMSU) A1/A2 and the AMSU-B instrument. It provides the initial estimate of temperature and moisture profiles for input to an infrared algorithm, as well as an all-weather set of profiles.
- The Ozone Mapping and Profiler Suite (OMPS) will measure solar scattered radiation to map the vertical and horizontal distribution of ozone in Earth's atmosphere using a nadir ultraviolet (UV) sensor and limb-scanning UV/visible (VIS) sensors.
- The Clouds and the Earth's Radiant Energy System (CERES) will measure solar-reflected and Earth-emitted radiation products continuing the measurements started with the Earth Observing System satellites and the Earth Radiation Budget Experiment.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**NPP**

CORRECTIVE ACTION PLAN SUMMARY

2010 ISSUES	CORRECTIVE ACTION PLAN
ISSUE 1: The NPP Project continued to be impacted by the late delivery of the Cross-track Infrared Sounder (CrIS) sensors provided by the NPOESS Integrated Program Office. The CrIS instrument delivery slipped from September 2009 to June 2010. This late delivery drove the launch date from January 2011 to October 2011 and resulted in an the associated cost increase of $ 47M. **NOTE:** This issue is outside of NASA's responsibility in the partnership with NOAA and DoD. **CURRENT STATUS:** As of June 2010, the last sensor Cross-track Infrared Sounder (CrIS) was delivered for integration onto the NPP spacecraft.	Programmatic – In February 2010, the Administration directed the restructuring of the NPOESS Program into separate civil and defense operational satellite systems. NOAA and NASA were assigned primary responsibility for the afternoon orbit. NASA's role in the restructured program is modeled after the procurement structure of the POES and GOES programs, with NASA performing work on a reimbursable basis for NOAA. Although the restructure occurred too late to improve the delivery date for the remaining sensor for NPP it has allowed NASA to manage the JPSS ground segment, which will be used for NPP and was also delayed under the NPOESS management structure. The ground segment is now on track for the October 2011 launch of NPP. Schedule-NASA has worked closely with the Integrated Program Office to monitor the instrument development and delivery status. The NPP project has worked to reduce the cost impact of the late delivery of the CrIS sensor by developing work-around activities and opportunities in the integration and test schedule. Specifically the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument integration was pulled forward while the spacecraft team waited for the CrIS delivery, which allowed for some additional risk reduction testing to be performed. An expanded VIIRS end-to-end radiometric spectral response test was performed in March to verify the VIIRS performance, earlier than planned in the original test flow. This opportunity reduced risk to the overall test flow by avoiding additional delays due to issues identified earlier in the flow.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: GPM

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**349.2**	**155.0**	**-**	**83.8**	**68.7**	**41.4**	**27.2**	**20.1**	**-**	**-**
FY 2011 Costs			128.8							
CSLE				14.7	14.9	6.1	3.4	1.4	1.6	
Administrative Labor Adjustments		0.6								
2011 MPAR Project Cost Estimate	**349.2**	**155.6**	**128.8**	**98.4**	**83.6**	**47.5**	**30.6**	**21.5**	**13.7**	**928.9**
Formulation	349.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	349.2
Development	0.0	155.6	128.8	98.4	80.3	33.4	14.4	3.0	0.9	514.8
Operations	0.0	0.0	0.0	0.0	3.3	14.1	16.2	18.5	12.8	64.9

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

The changes to the project's budget reflect the deletion of a second GPM Microwave Imager (GMI-2), which would have been available to fly on a future Low-Inclination Observatory (LIO).

Project Purpose

The GPM mission will advance the measurement of global precipitation, making possible high spatial resolution precipitation measurements available at a three-hour or less refresh rate over much of the globe. A joint mission with JAXA, GPM will provide the first opportunity to calibrate measurements of global precipitation (including the distribution, amount, rate, and associated heat released) across tropic, mid-latitude, and polar regions.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
MPAR Project In Development:	GPM

The GPM mission has the following scientific objectives:

- Advance precipitation measurement capability from space through combined use of active and passive remote-sensing techniques. These advanced measurements will be used to calibrate dedicated and operational passive microwave sensors, with the goal of achieving global sampling;

- Advance understanding of global water/energy cycle variability and fresh water availability. Improved measurements of the space-time variability of global precipitation will substantially close the water/energy budget and elucidate the interactions between precipitation and other climate parameters;

- Improve climate prediction by providing the foundation for better understanding of surface water fluxes, soil moisture storage, cloud/precipitation microphysics and latent heat release in Earth's atmosphere;

- Advance Numerical Weather Prediction (NWP) skills through more accurate and frequent measurements of instantaneous rain rates with better error characterizations, and the development of improved assimilation methods; and

- Improve flood-hazard and fresh-water-resource prediction capabilities through better temporal sampling and wider spatial coverage of high-resolution precipitation measurements, and innovative designs in hydro-meteorological modeling.

For more information see http://gpm.gsfc.nasa.gov/.

Project Parameters

The GPM project includes a Core Observatory Spacecraft and a robust set of spare GPM Microwave Imager (GMI) instrument subsystems to ensure the GMI instrument, NASA's instrument contribution to the Core Observatory, is ready on schedule. The Core Observatory will leverage passive microwave measurements from other operating and planned "satellites of opportunity" by calibrating their measurements to its own. The resulting sampling rate over different areas of the globe will depend on the number and orbits of the satellites of opportunity, but given the prevalence of passive microwave instruments on operational satellite systems, the global sampling will be robust.

The NASA Core Observatory will fly in a 65 degree inclined orbit at an altitude of 407 kilometers; the 65 degree orbit provides improved latitude coverage over TRMM (whose orbit was inclined 35 degrees). The Core Observatory's two scientific instruments will provide active and passive microwave measurements of precipitation.

The JAXA-supplied Dual-frequency Precipitation Radar (DPR) instrument has cross-track swath widths of 245 and 120 kilometers, in Ku-band and Ka-band, providing three-dimensional observation of rain and an accurate estimation of rainfall rate. The KuPR (13.6 GHz) subsystem of the DPR is an updated version of the highly successful radar flown on TRMM.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**GPM**

The GMI instrument is a conically-scanning radiometer that will provide significantly improved spatial resolution compared to the TRMM Microwave Imager (TMI).

The Core Observatory Spacecraft will be launched from Tanegashima Space Center, Japan, on an H-IIA launch vehicle. The DPR and GMI data will be relayed using the TDRSS multiple access and single access service.

Project Commitments

The GPM Core Observatory is planned for a launch in July 2013 to begin a three-year prime mission (five-year goal). When calibrated with existing and planned passive microwave measurements from other satellites, GPM will provide global measurements of precipitation with a sampling frequency of three hours or less over much of the globe.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Core Observatory	GSFC	Provides platform for the GMI and JAXA-supplied DPR instruments.	Same Same	
Low-Inclination Observatory	N/A N/A		Changed to be partner-provided	Second GMI instrument deleted
Dual-frequency Precipitation Radar (DPR)	JAXA	Provides cross-track swath widths of 245 and 120 kilometers, for the Ku precipitation radar (KuPR) and Ka-band precipitation radar (KaPR).	Same Same	
GMI GSFC		Provides 13 microwave channels ranging in frequency from 10 GHz to 183 GHz; four high frequency, millimeter-wave, channels about 166 GHz and 183 GHz. 1.2 meter diameter antenna.	Same Same	
Launch Vehicle	JAXA	H-IIA	Same	Same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: GPM

Schedule Commitments

GPM entered formulation in July 2002. The below milestone dates reflect the December 2009 KDP-C commitments.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
KDP-C	Dec 2009	Dec 2009	Dec 2009
Core Observatory LRD	Jul 2013	Jul 2013	Jul 2013

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Global Precipitation Measurement (GPM)	2010	555.2	2011	514.8	-7	Launch Readiness	07/2013	07/2013	0

Note: The changes to the project's budget reflect the deletion of a second GPM Microwave Imager (GMI-2), which would have been available to fly on a future LIO.

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**555.2**	**514.8**	**-40.4**
Aircraft/Spacecraft	151.2	156.2	5
Payloads	91.2	60.3	-30.9
Systems I&T	6.8	7.2	0.4
Launch Vehicles/Services	1.5	2.0	0.5
Ground Systems	30.5	24.9	-5.6
Science/Technology	28.4	28.1	-0.3
Other direct project cost	245.6	236.1	-9.5

Note: The changes to the project's budget reflect the deletion of a second GPM Microwave Imager (GMI-2), which would have been available to fly on a future LIO.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: GPM

Project Management

GSFC has project management responsibility. The Agency Program Management Council has program oversight responsibility.

The Earth Sciences Division Director is the responsible official for this project.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Core Observatory	GSFC	GSFC	None
Core Observatory: GMI	GSFC	GSFC	None
Core Observatory: DPR	GSFC	GSFC	JAXA
Launch vehicle and services: Core Observatory	GSFC N	one	JAXA
Ground Systems	GSFC	GSFC	None

Acquisition Strategy

The GPM instrument was selected through open competition in FY 2005. The Ball Aerospace and Technologies Corporation (BATC) will build the GMI instrument for GPM. The GPM core spacecraft will be an in-house development at GSFC. The DPR instrument and launch vehicle for the Core Observatory will be provided by a foreign partner (JAXA).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	HQ and GSFC	12/2009	System Integration Review (SIR)	5/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Non-NASA Constellation elements	Expanded global sampling depends on data from "spacecraft of opportunity" that are not part of this project.	NASA is developing data algorithms that allow GPM to make the broadest possible use of microwave instruments on other spacecraft; NASA participates in interagency and international planning processes for operational Earth observation measurements to maximize the leverage opportunities for GPM.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: LDCM

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**434.5**	**106.0**	**-**	**152.0**	**64.1**	**1.5**	**1.5**	**1.6**	**-**	**-**
FY 2011 Costs			163.0							
CSLE				7.4	3.8	0.7	0.7	0.7	1.2	
Administrative Labor Adjustments		0.6								
2011 MPAR Project Cost Estimate	**434.5**	**106.6**	**163.0**	**159.3**	**67.9**	**2.2**	**2.2**	**2.3**	**3.6**	**941.6**
Formulation	341.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	341.4
Development	93.1	106.6	163	159.3	65.6	0.0	0.0	0.0	0.0	587.6
Operations	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.3	3.6	12.5

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- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
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- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

The LDCM project, which was approved to proceed with development in December 2009, now has a fully integrated budget including the development and accommodation of TIRS.

Project Purpose

Unprecedented changes in land cover and use are having profound consequences for weather and climate change, ecosystem function and services, carbon cycling and sequestration, resource management, the national and global economy, human health, and society. The Landsat data series, begun in 1972, is the longest continuous record of changes in Earth's surface as seen from space and the only satellite system designed and operated to repeatedly observe the global land surface at moderate resolution. Landsat data are available at an affordable cost, providing a unique resource for

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**LDCM**

people who work in agriculture, geology, forestry, regional planning, education, mapping, and global change research.

The purpose of LDCM is to extend the record of multi-spectral, moderate resolution Landsat-quality data, and to meet U.S. Government operational and scientific requirements for observing land use and land change.

For additional information, visit the LDCM mission Home Page: http://ldcm.nasa.gov/.

Project Parameters

LDCM is being developed for an LRD that will minimize a potential data gap in the archive due to the fuel-limited life of Landsat-7. Recent analyses by the USGS and NASA have estimated the Landsat-7 mission should continue to operate through at least the end of 2012. The LDCM mission completed its Confirmation Review on November 30, 2009, and its KDP-C transition review on December 16, 2009. Due to the high national importance of the mission and the need to maintain the continuity of the Landsat data record, NASA and USGS will implement the LDCM mission for a December 2012 launch, providing necessary budget and other resources to ensure all mission elements are ready for this launch date. A probabilistic analysis has determined that the launch date could move as far as June 2013, driven by the late addition of the TIRS instrument. However, the LDCM project has been directed to execute all necessary contracts and actions to accomplish the December 2012 Launch Readiness Date.

LDCM consists of a two science instruments (the Operational Land Imager and the Thermal Infrared Sensor), a spacecraft, and a mission operations element. The LDCM is in implementation and system level requirements are baselined to provide the following system-level performance parameters:

- Earth Spatial-Temporal Coverage: 16-day repeat coverage of the global land mass;
- - Spatial Resolution: 30 meters (visible, NIR, SWIR), 120 meters (thermal); 15 meters (panchromatic);
- - Radiometric Performance: accuracy, dynamic range, and precision sufficient to detect land cover change using historic Landsat data;
- - Data: 185-kilometer cross track-by-180-kilometer along track multi-spectral image of Earth's surface; and
- - Mission Life: five years

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: LDCM

Project Commitments

After launch, the spacecraft and OLI instrument will operate for a minimum of five years. The TIRS instrument will operate for a minimum of three years.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
OLI	Ball Aerospace and Technology Corporation	Provide Landsat-equivalent data to extend the Landsat data of Earth's land surface for five years.	Same	Same
TIRS GSFC		Provide Landsat-equivalent thermal data to extend the Landsat data of Earth's land surface for three years.	New Same	
Spacecraft	General Dynamics	Provide performance and reliability commensurate with OLI and TIRS data requirements.	Same	Same
Launch Vehicle	ULA	Provide launch service access to space.	Same	Same
Mission Operations Element	Hammers Corporation	Provide capability for command and control, mission scheduling, long-term trending and analysis, and flight dynamics analysis.	Same	Same

Schedule Commitments

LDCM completed its spacecraft CDR and mission CDR in FY 2010. Due to the high national importance of the mission and the need to maintain continuity of the Landsat data record, NASA and USGS will strive to launch LDCM in December 2012. The LDCM project has been directed to execute all necessary contracts and actions to accomplish the December 2012 launch. Consistent with NASA policies regarding commitments to cost and schedule, the LDCM launch shall be no later than June 2013.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Formulation			
Award OLI contract	July 2007	July 2007	July 2007
Confirmation Review	Dec 2009	Dec 2009	Dec 2009
Critical Design Review (CDR)	Apr 2010	Apr 2010	Apr 2010

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: LDCM

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
PSR	Sep 2012	Sep 2012	Sep 2012
Launch	Jun 2013	Jun 2013	Jun 2013

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Landsat Data Continuity Mission (LDCM)	2010	583.4	2011	587.6	1	Launch Readiness	6/2013	6/201 3	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**583.4**	**587.6**	**4.2**
Aircraft/Spacecraft	116.7	113.0	-3.7
Payloads	131.3	145.7	14.4
Systems I&T	1.7	2.0	0.3
Launch Vehicle	126.4	127.2	0.8
Ground Systems	10.7	15.8	5.1
Science/Technology	13.3	9.5	-3.8
Other Direct Project Costs	183.3	174.4	-8.9

Project Management

LDCM is under the Earth Systematic Missions program within the Earth Science Division (ESD) of SMD. The NASA Associate Administrator (AA) is the decision authority; the ESD Director is the responsible official; and GSFC is the lead management organization.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: LDCM

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Operational Land Imager	GSFC	GSFC	None
Thermal Infrared Sensor	GSFC	GSFC	None
Spacecraft	GSFC	GSFC	None
Ground System	GSFC	GSFC	U.S. Department of Interior-U.S. Geological Survey
Mission Operations	GSFC	GSFC	U.S. Department of Interior-U.S. Geological Survey

Acquisition Strategy

NASA's acquisition plan includes acquiring separate elements of the LDCM mission through open competition, with GSFC acting as the mission integrator and leading the element source selections. NASA has issued competitively selected contracts for the following major elements: Ball Aerospace and Technology Corporation for the development of the Operational Land Imager in July 2007; General Dynamics Corporation for the development of the spacecraft in April 2008; and Hammers Corporation for the development of the Mission Operations Element (MOE) in September 2008. The Thermal Infrared Sensor will be designed and built in-house at GSFC utilizing civil servants and support contractor personnel.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	HQ and GSFC	9/2008	Systems Requirement Review - Successful	N/A
Performance	HQ and GSFC	7/2009	Mission Preliminary Design Review - Successful	N/A
Performance	HQ and GSFC	5/2010	Mission Critical Design Review	N/A
Performance	HQ and GSFC	N/A	Systems Integration Review	08/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Thermal Infrared Sensor (TIRS) development risk	The TIRS instrument has an aggressive development schedule due to late addition to the instrument complement and there is a risk that TIRS will not be delivered on schedule to meet the LDCM launch readiness date.	The LDCM project will develop alternative observatory integration and test scenarios to allow for late arrival of TIRS. In the event that TIRS cannot be delivered in time to meet the LDCM launch date, a flyable mass model will be developed.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: Aquarius

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**221.5**	**22.3**	**-**	**4.9**	**4.6**	**4.9**	**5.1**	**5.2**	**-**	**-**
FY 2011 Costs			21.0							
CSLE				0.5	0.5	0.3				
Extended Ops Budget not included in LCC						-1.5	-5.1	-5.2		
2011 MPAR Project Cost Estimate	**221.5**	**22.3**	**21.0**	**5.4**	**5.1**	**3.7**	**0.0**	**0.0**	**0.0**	**279.0**
Formulation	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.6
Development	185.9	22.3	19.1	0.0	0.0	0.0	0.0	0.0	0.0	227.3
Operations	0.0	0.0	1.9	5.4	5.1	3.7	0.0	0.0	0.0	16.1

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- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Extended Ops Budget not included in LCC" reflects budgeted funds for operations that continue beyond the period of prime operations for which the project was baselined.*

Explanation of Project Changes

The FY 2011 budget for Aquarius reflected the cost for a launch no earlier than December 2010. Spacecraft development delays at NASA's foreign partner, Argentina's National Committee of Space Activities (CONAE) spacecraft have delayed the launch to no earlier than June 2011.

Project Purpose

The Aquarius mission will investigate the links between the global water cycle, ocean circulation, and climate. It will observe and model variations of sea surface salinity, and how these relate to changes in the water cycle and ocean circulation. This will yield an unprecedented view of the oceans' role in climate and weather. For more information visit: http://aquarius.gsfc.nasa.gov/.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: Aquarius

Project Parameters

Aquarius is an instrument on Argentina's CONAE spacecraft, Satellite de Aplicaciones Cientificas-D (SAC-D). The combined NASA and CONAE instruments and spacecraft form the Aquarius/SAC-D observatory. This observatory will be launched into a polar, Sun-synchronous orbit that allows global coverage of ice-free ocean surfaces consistent with Aquarius/SAC-D science observational targets. The Aquarius instrument includes an L-band microwave radiometer (1.413 GHz) and scatterometer (1.26 GHz). The radiometer will measure the surface brightness temperature, which is related to the surface emissivity and physical temperature of the seawater. The surface emissivity is determined by the dielectric constant of seawater, which is related to salinity. The scatterometer is required to provide coincident information of sea surface roughness, a critical correction term for retrieval of sea surface salinity.

Project Commitments

Aquarius is manifested to launch no earlier than June 2011 to begin a three-year prime mission to measure sea surface salinity with the precision, resolution, and coverage needed to characterize salinity variations and investigate the linkage between ocean circulation, Earth's water cycle, and climate variability.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Aquarius Instrument (integrated radiometer/ scatterometer)	JPL	L-band microwave radiometer at 1.413 GHz; scatterometer at 1.26 GHz; SSS measurements with root-mean-sq random errors and systematic biases <= 0.2 psu on 150 km sq scales over ice-free oceans.	Same	Same
Spacecraft	CONAE	SAC-D	Same	Same
Launch Vehicle	Boeing	Delta II	Same	Same
Data Management	GSFC N/A		Same	Same
Operations	CONAE	Command and telemetry	Same	Same

Schedule Commitments

The Aquarius mission entered a Risk Mitigation Phase (RMP) in July 2002. Following the RMP, the project was authorized to proceed to a formulation phase in December 2003. The Aquarius mission was authorized by the NASA Science Mission Directorate to proceed to development on October 12, 2005. In November 2007, the NASA Science Mission Directorate Program Management Council approved a replan of Aquarius, including a launch delay to May 2010. In December 2009, the NASA Science Mission Directorate Program Management Council approved another replan of Aquarius, including a launch delay manifesting the Aquarius/SAC-D mission for a January 2011 launch.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: Aquarius

In September 2010, NASA, in coordination with CONAE, made the decision to delay the launch readiness date to June 2011 based on the progress on SAC-D testing and assessment of the remaining schedule. The rebaseline of the Aquarius project for this change is scheduled to take place in March 2011.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Mission Confirmation Review	September 2005	September 2005	September 2005
Mission CDR	August 2007	July 2008	July 2008
Aquarius Instrument Pre-ship Review [FY 2008 APG]	May 2008	May 2009	May 2009
Launch	March 2009	January 2011	June 2011

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Aquarius	2007	192.6	2011	227.3	18	Launch Readiness	07/2009	06/2011	23

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**192.6**	**227.3**	**34.7**
Payloads	55.4	98.2	42.8
Launch Vehicle/Services	78.9	82.1	3.2
Ground Systems	5.5	5.2	-0.3
Science/Technology	10.9	11.6	0.7
Other Direct Project Cost	41.9	30.2	-11.7

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth Systematic Missions
MPAR Project In Development: Aquarius

Project Management

The Jet Propulsion Laboratory is responsible for project management. The Science Mission Directorate Program Management Council is responsible for program oversight. The Earth Science Division Director is the responsible official for this project.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Launch Vehicle	KSC	KSC	None
Ground System	JPL	GSFC	None
Aquarius Instrument	JPL	JPL	None
Spacecraft	CONAE	None	CONAE
Radiometer	JPL	GSFC	None
Data management	GSFC	GSFC/JPL	None
Mission operations	CONAE	None	CONAE

Acquisition Strategy

Aquarius was competitively selected from proposals submitted in response to ESSP AO 3. All elements of the project were included in that selection, and there are no other planned major procurements.

The launch vehicle procurement was awarded to Boeing. GSFC and JPL were selected for the remaining project elements not provided by CONAE.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Aquarius Standing Review Board	7/2010	Aquarius Replan Review -- Determined readiness of Aquarius instrument integration with the SAC-D Observatory (Phase D). Recommendation to proceed to Phase D.	3/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Spacecraft Development Delays	Further delays could impact launch date.	Monitor Comision Nacional De Actividades Espaciales (CONAE) progress and confirm commitments; reassess available schedule reserves.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Earth Science
Program:	Earth Systematic Missions
MPAR Project In Development:	Aquarius

Corrective Action Plan (as submitted in Report on Program and Cost Assessment January 11, 2011 – as required under 1203)

Project Description: NASA's Aquarius project is part of a joint undertaking with the Comisión Nacional de Actividades Espaciales (CONAE), the space agency of Argentina, and referred to as the Aquarius/SAC-D project. The implementation of Aquarius/SAC-D is governed by a Memorandum of Understanding (MOU), dated March 2, 2004. The Aquarius prime mission life is planned and funded for three years with a minimum requirement of one year of operations. The Aquarius project will implement an exploratory sensor capability designed to make pioneering space-based measurements of sea surface salinity (SSS) with the precision, resolution, and coverage needed to characterize salinity variations and investigate the linkage between ocean circulation, Earth's water cycle, and climate variability. Salinity data are required to determine seawater density, which in turn governs ocean circulation. SSS variations are governed by freshwater fluxes due to precipitation, evaporation, runoff, and the freezing and melting of ice.

The Aquarius SSS measurements will be used to address two key areas of NASA's Earth Science research strategy: 1) how global precipitation, evaporation, and the cycling of water are changing; and 2) how climate variations induce changes in the global ocean circulation. In meeting these objectives, Aquarius will also validate a space-based measurement approach and analysis concept that could be used for future systematic SSS monitoring missions.

The Aquarius/SAC-D project will be conducted using an observatory made up of the NASA-provided Aquarius instrument, SAC-D science instruments, and the SAC-D spacecraft bus (service platform) contributed by CONAE. CONAE's SAC-D requirements are technically and scientifically compatible with Aquarius. However, Aquarius is designated in the MOU as the prime mission instrument on SAC-D. The Aquarius/SAC-D mission operations will be conducted using an integrated mission operations system consisting of the CONAE observatory operations control center in Argentina, the Goddard Space Flight Center (GSFC) Aquarius science planning and data processing center, and the Jet Propulsion Laboratory (JPL) Physical Oceanography Distributed Active Archive Center (PODAAC) for data archive and distribution. NASA will be providing the Delta-II launch vehicle.

The NASA instrument, Aquarius, will retrieve SSS by microwave remote sensing of surface brightness temperature at L-band, which is governed by the surface salinity, temperature, and roughness (due to wind and waves). An integrated L-band microwave radiometer/scatterometer will be developed and deployed as the salinity measuring instrument, consisting of three beams in a pushbroom configuration. The radiometer (1.413 GHz) will measure the surface brightness temperature, which is related to the surface emissivity and physical temperature of the seawater. The surface emissivity is determined by the dielectric constant of seawater, which is related to salinity. The scatterometer (1.26 GHz) is required to provide coincident information of sea surface roughness, a critical correction term for retrieval of sea surface salinity. The Baseline Science Mission enables study of the relevant oceanic processes on intraseasonal to interannual time scales by resolving the SSS with 0.2 practical salinity units (psu) accuracy on monthly time scales for at least three years.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**Aquarius**

CORRECTIVE ACTION PLAN SUMMARY

ISSUE	CORRECTIVE ACTION PLAN
ISSUE 1: Delays in the CONAE (Argentina Space Agency) SAC-D development (primarily associated with several minor technical issues and insufficient planning for integration and test activities) have led to NASA cost overruns and schedule slips. **NOTE:** This issue is entirely outside of NASA's responsibility in the partnership with Argentina. **CURRENT STATUS:** NASA has taken steps to improve insight and provide assistance to CONAE, within the limitations of ITAR.	Programmatic – NASA instituted a weekly teleconference with senior CONAE management to review project status and ensure all parties are well informed. Technical - JPL has placed a senior systems engineer on site at the integration and tests facilities in Argentina and Brazil, respectively with the purpose of monitoring CONAE progress and advising within the bounds of the JPL technical assistance agreement. Cost - The Aquarius project has worked to minimize the cost impact of schedule delays by reducing workforce to the lowest level required to support the remaining work. The resulting cost avoidance is estimated to be approximately $1.5M. Schedule - NASA has been working closely with CONAE to ensure the schedule is appropriate (based on NASA experience on missions of similar scope) for the remaining work, while ensuring mission success. In the past, the schedules have been optimistic, with not enough detail to make realistic assessments of the effort to complete the mission.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth Systematic Missions**
MPAR Project In Development:	**Aquarius**

ISSUE	CORRECTIVE ACTION PLAN
ISSUE 2: Contamination of the SAC-D Observatory Dual Thruster Modules (DTMs) has led to CONAE schedule delays. **NOTE**: This issue is the responsibility of CONAE. **CURRENT STATUS:** The refurbishment of all of the DTM flight units has been completed and the flight units were re-integrated with the observatory in October 2010.	Technical - NASA/JPL provided support to CONAE on the removal, shipment to the US vendor, and refurbishment of the DTMs. Without NASA support, it is estimated that the refurbishment effort would have resulted in a significant delay of four months. The work NASA conducted minimized the schedule delay (by as much as 2 months) and reduced the potential for further damage to the Observatory and/or an on-orbit failure. Schedule – Since this issue occurred concurrently with the other issues noted in ISSUE 1, it is difficult to determine the exact impact of the DTMs contamination on the overall schedule. However, while the entire refurbishment process took approximately 2 months, the impact to the project schedule was more likely 4-6 weeks.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth System Science Pathfinder
MPAR Project In Development: OCO-2

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**29.1**	**62.0**	**-**	**91.0**	**41.0**	**13.0**	**4.0**	**0.0**	**-**	**-**
FY 2011 Costs			109.8							
2011 MPAR Project Cost Estimate	**29.1**	**62.0**	**109.8**	**91.0**	**41.0**	**13.0**	**4.0**	**0.0**	**0.0**	**349.9**
Formulation	28.9	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.9
Development	0.2	30.0	109.8	91.0	18.0	0.0	0.0	0.0	0.0	249.0
Operations	0.0	0.0	0.0	0.0	23.0	13.0	4.0	0.0	0.0	40.0

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*

Project Purpose

Data received from OCO-2 will support climate research by enabling an improved understanding of natural, distributed CO2 sources and sinks and ocean/atmosphere and land/atmosphere CO2 exchange processes. OCO-2 measurements will initiate a global time series of atmospheric CO2 for direct support of policy development and verification of regulations and environmental treaties. Rapid development and launch of OCO-2 is a key element of the President's Budget.

OCO-2 replaces the original OCO, which failed to reach orbit in February 2009 due to a launch vehicle anomaly. OCO-2 will utilize OCO's detailed design and implementation approach to the greatest possible degree to reduce risk. The mission objectives of OCO and OCO-2 are identical.

Project Parameters

The OCO-2 mission consists of a dedicated spacecraft with a single instrument, flying in a near-polar, Sun-synchronous orbit launched by an expendable launch vehicle. The orbit's early afternoon equator crossing time maximizes the available signal and minimizes diurnal biases in CO2 measurements associated with photosynthesis. The OCO-2 flight system uses hardware components, software, and processes with space flight heritage, in particular drawing from the spacecraft and mission design implemented for the OCO mission. The spacecraft structure is made of honeycomb panels that form a hexagonal shape. This structure houses the instrument and the spacecraft bus components. Panels with solar cells are attached and stowed such that the whole structure fits inside the small fairing of the

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Earth Science**
Program:	**Earth System Science Pathfinder**
MPAR Project In Development:	**OCO-2**

Taurus XL launch vehicle. For the OCO-2 mission, the spacecraft has been elongated to accommodate the instrument and the instrument has been embedded into the structure of the spacecraft, exactly as was done for the OCO spacecraft. The instrument consists of a single telescope feeding three high-resolution grating spectrometers. The optics will be cooled to approximately 270 Kelvin (K) and the Focal Plane Arrays (FPAs) to approximately 120 K. The instrument will measure CO2 and O2 near-infrared absorptions from reflected sunlight. Remote sensing retrieval algorithms will process these data to yield estimates of the column-averaged CO2 dry air mole fraction, XCO2. The total weight of the observatory is about 530 kilograms. The original OCO successfully completed qualification of this configuration prior to launch.

Project Commitments

The OCO-2 is planned to launch in February 2013 to begin a two-year mission. OCO-2 will provide atmospheric CO2 measurements with near global coverage of the sunlit portion of Earth on a 16-day repeat cycle.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Spacecraft	Orbital Sciences Corp	Provides platform for the instrument	New Same	
OCO-2 Instrument	JPL	Three channel, high-resolution grating spectrometer measuring CO2 and O2 near-infrared absorptions from reflected sunlight	New Same	
Launch Vehicle	Orbital Sciences Corp	Taurus XL	New	Same

Schedule Commitments

Based on design maturity due to the heritage of OCO, OCO-2 entered Formulation in February 2010. Completion of KDP-C and transition to Development occurred in September 2010.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
KDP-C	N/A	December 2010	September 2010
LRD	N/A	February 2013	February 2013

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth System Science Pathfinder
MPAR Project In Development: OCO-2

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
OCO-2	2011	249.0	2011	249.0	0	Launch Readiness	02/2013	02/2013	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**249.0**	**249.0**	**0**
Spacecraft	42.0	42.0	0
Payload	39.4	39.4	0
System I&T	2.4	2.4	0
Launch Vehicle	67.6	67.6	0
Ground System	7.5	7.5	0
Science/Technology	10.0	10.0	0
Other	80.1	80.1	0

Project Management

JPL has project management responsibility for OCO-2. The Science Mission Directorate Program Management Council has program oversight responsibility. The Earth Sciences Division Director is the responsible official.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Spacecraft	JPL	None	None
Instrument	JPL	JPL	None
Ground System	JPL	JPL	None
Launch Vehicle	JPL	KSC	None

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Earth Science
Program: Earth System Science Pathfinder
MPAR Project In Development: OCO-2

Acquisition Strategy

The OCO-2 spacecraft will be built by Orbital Sciences Corporation. A sole source procurement is being pursued to maintain the same configuration as OCO. The OCO-2 instrument will be built in-house at JPL.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance OCO-2	SRB	09/2010	OCO-2 will complete a KDP-C Confirmation Review, to establish the mission development baseline.	02/2012

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Launch Vehicle Failure	If Taurus XL launch vehicle failure occurs, then there will be a loss of mission.	NASA is employing a rigorous Return-to-Flight program on the Taurus XL launch vehicle for the Glory mission. The OCO team is being provided insight into these results.
Single String Component Failure	If an OCO-2 single string (i.e. no redundancy) component fails, then there may be a loss of mission.	OCO-2 (based on the competed OCO design) was designed to have some single string components. Thorough analyses and testing is being performed to mitigate this risk as much as possible.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Living with a Star
MPAR Project In Development: RBSP

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	271.3	121.0	-	91.2	29.7	21.5	8.7	0.0	-	-
FY 2011 Costs			140.0							
CSLE				1.0	0.5	0.5	0.4			
Administrative Labor Adjustments		0.2								
2011 MPAR Project Cost Estimate	271.3	121.2	140.0	92.2	30.2	22.0	9.1	0.0	0.0	686.0
Formulation	88.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.2
Development	183.1	121.2	140.0	81.6	8.3	0.0	0.0	0.0	0.0	534.2
Operations	0.0	0.0	0.0	10.7	21.9	22.0	9.1	0.0	0.0	63.7

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- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

RBSP was confirmed in FY 2009 to proceed into the development phase, and will launch in May 2012. The total funding for RBSP has not changed.

Project Purpose

The RBSP mission will observe the fundamental processes that energize and transport radiation particles in Earth's inner magnetosphere (the area in and around the Earth's radiation belts). These dynamic processes operate throughout the universe at other planets and stars, and they continuously operate within Earth's immediate space environment.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Living with a Star
MPAR Project In Development: RBSP

The primary science objective of the RBSP mission is to provide understanding, ideally to the point of predictability, of how populations of relativistic electrons and penetrating ions in space form or change in response to variable inputs of energy from the Sun. The RBSP mission lifetime will provide sufficient local time, altitude, and event coverage to improve understanding, and determine the relative significance of the various mechanisms that operate within the radiation belts.

RBSP observations will provide new knowledge on the dynamics and extremes of the radiation belts that are important to all technological systems that fly in and through geospace.

Project Parameters

The RBSP mission is comprised of two identical spacecraft in elliptical, low-inclination orbits that travel independently through Earth's radiation belts to distinguish time and space variations in the measured ions, electrons, and fields.

Project Commitments

The RBSP project will launch two identical spacecraft in FY 2012 to begin a two-year prime mission.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
EELV	KSC	Deliver a spacecraft to operational orbit	Same Same	
Energetic Particle, Composition and Thermal Plasma Suite (ECT)	University of New Hampshire	Measure the electron and ion spectra, and composition to understand the electron and ion changes	Same Same	
Radiation Belt Storm Probes Ion Composition Experiment (RBSPICE)	New Jersey Institute of Technology	Measure the ring current in the magnetosphere during geomagnetic storms	Same Same	
Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS)	University of Iowa	Measure the magnetic fields and plasma waves	Same Same	
Electric Field and Waves Instrument for the NASA RBSP Mission (EFW)	University of Minnesota	Measure the electric fields in the radiation belts	Same Same	
Proton Spectrometer Belt Research (PSBR)	National Reconnaissance Office	Measure the inner Van Allen belt protons	Same Same	
Spacecraft	JHU-APL	Operate science instruments in high radiation; transmit science data to ground	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Living with a Star
MPAR Project In Development: RBSP

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Ground System	Primary ground station at JHU-APL; instrument operation is distributed among investigators	Receive science data from two spacecraft; distribute to archive	Same	Same

Schedule Commitments

The RBSP project was authorized to begin formulation in September 2006 when the selections for science investigations were announced. It was confirmed to proceed into development on December 19, 2009.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Begin Implementation	January 2009	January 2009	January 2009
Critical Design Review	December 2009	December 2009	December 2009
System Integration Review	November 2010	November 2010	October 2010
Launch Readiness Review	May 2012	May 2012	May 2012

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Radiation Belt Storm Probes (RBSP)	2009	533.9	2011	534.2	0	Launch Readiness	05/2012	05/2012	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**533.9**	**534.2**	**0.3**
Spacecraft	85.6	113.0	27.4
Payload	95.4	96.4	1.0

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Living with a Star
MPAR Project In Development: RBSP

System I&T	36.9	39.4	2.5
Launch Vehicle	133.6	133.6	0.0
Ground System	16.3	19.5	3.2
Science/Technology	3.1	3.9	0.8
Other	163.0	128.4	-34.6

Project Management

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Ground Systems	JHU-APL	None	None
Data Analysis	JHU-APL	None	National Reconnaissance Office
Instrument Development	JHU-APL	None	National Reconnaissance Office
Spacecraft design, integration with instrument, and test	JHU-APL Non	e	None
Mission Operations	JHU-APL	None	None
Expendable Launch Vehicle	KSC	None	None

Acquisition Strategy

The RBSP spacecraft and ground system are being designed, developed, and tested at the JHU-APL. The acquisition of sub-contracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the JHU-APL Procurement Office. Instrument development participants include the University of Iowa, University of Minnesota, New Jersey Institute of Technology, and the University of New Hampshire, as well as contributions from the National Reconnaissance Office and the Czech Republic.

The ground system components were defined during the formulation phases (Phases A and B) and include a mission operations center at the JHU-APL.

The Energetic Particle, Composition and Thermal Plasma Suite (ECT), Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS), Electric Field and Waves Instrument for the NASA RBSP mission (EFW), and Radiation Belt Storm Probes Ions Composition Experiment (RBSPICE) science investigations were procured through announcements of opportunity. The Proton Spectrometer Belt Research (PSBR) instrument is being contributed through an agreement with the National Reconnaissance Office.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Living with a Star
MPAR Project In Development: RBSP

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	Senior Review Board	10/2008	Preliminary Design Review. The review concluded that the RBSP design was sufficiently mature to proceed to KDP-C.	N/A
Performance SRB		12/2009	Critical Design Review: The review concluded that there were no significant issues and the project should continue as planned.	N/A
Performance SRB		10/2010	System Integration Review: The review concluded that the project was ready to proceed with I&T.	N/A

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Complete Electric and Magnetic Field Instrument Suite and Integrated Science End-to-End testing	If the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) main Electronics Box Engineering Model 2 (EM2) is not successfully integrated and tested per the EM2 test plan and schedule, then the flight build and delivery will be delayed.	Hold Flight Manufacturing Readiness Reviews. Complete EM 2 environmental testing and characterization. Complete EM2 I&T peer review.
XCVR Qualification program	If the transceiver qualification program does not perform to their re-planned schedule, then the project's I&T schedule will be delayed.	Provide bi-weekly schedule updates to the integrated master schedule. Burn Qualification model on the RTAX, the field programmable gate array. Conduct Engineering Design Review of Qualification model.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Solar Terrestrial Probes
MPAR Project In Development: MMS

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	226.0	130.1	-	146.2	153	153	30.5	18.6	-	-
FY 2011 Costs			156.8							
CSLE				18	15.3	13	4.1	1.9	1.0	
Administrative Labor Adjustments		0.7								
2011 MPAR Project Cost Estimate	226.0	130.8	156.8	164.3	168.3	166.0	34.5	20.4	15.4	1082.6
Formulation	172.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	172.9
Development	53.0	130.8	156.8	164.3	168.3	166.0	17.9	0.0	0.0	857.3
Operations	0.0	0.0	0.0	0.0	0.0	0.0	16.6	20.4	15.4	52.4

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- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

MMS has no change in life cycle cost. Sweden is not able to deliver the deployment mechanism of their electric field instrument contribution as planned. This mechanism will now be built by NASA through an existing partner institution, the University of New Hampshire.

Project Purpose

MMS will use four identically instrumented spacecraft to perform the first definitive study of magnetic reconnection in space. Reconnection occurs in all astrophysical plasma systems but can be studied efficiently only in the Earth's magnetosphere. Magnetic reconnection is thought to be of great importance for energy transfer throughout the universe and is an efficient and fast acceleration mechanism. Reconnection is the primary process by which energy is transferred from the solar wind to

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Heliophysics**
Program:	**Solar Terrestrial Probes**
MPAR Project In Development:	**MMS**

Earth's magnetosphere and is the critical physical process determining the size of a space weather geomagnetic storm. MMS will determine why magnetic reconnection occurs, where it occurs, how it varies, how magnetic energy is coupled into heat and particle kinetic energy, and how this energy is coupled into the surrounding plasma.

For more information about MMS, please see http://stp.gsfc.nasa.gov/missions/mms/mms.htm.

Project Parameters

The MMS instrument payload will measure electric and magnetic fields and plasmas within the small-scale diffusion regions where magnetic reconnection occurs. High temporal and spatial resolution measurements will permit direct observation of these physical processes. The four spacecraft and instrument suites have identical design requirements. A two-phase, low-inclination orbit will probe both the dayside magnetopause and the nightside magnetotail neutral sheet where reconnection is known to frequently occur. The primary target of Phase 1 is the dayside magnetopause reconnection region. Phase 2 will focus on the near-Earth neutral line in the nightside magnetotail. The four spacecraft will fly in a tetrahedron formation and the separation between the observatories will be adjustable over a range of 10 to 400 kilometers during science operations in the area of interest. The mission design life is two years.

Project Commitments

NASA plans to launch four identically-instrumented spacecraft on an Evolved Expendable Launch Vehicle (EELV) into a highly elliptical Earth orbit in March 2015 and begin two years of scientific measurements that will enable an understanding of fundamental plasma physics processes associated with magnetic reconnection.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Launch Vehicle	KSC	Deliver ~4,000 kg payload consisting of four observatories to a highly elliptical Earth orbit.	Same Same	
Ground Systems	GSFC	Provide during operations minimum science data payback of ~4 Gbits of data per observatory each day.	Same Same	
Spacecraft	GSFC	Deliver high-rate data from instruments to ground station with a high accuracy for two years.	Same Same	
Electric Field Instruments	UNH	Provide measurements of electric fields (time resolution 1 ms) and magnetic fields (time resolution 10 ms)	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Solar Terrestrial Probes
MPAR Project In Development: MMS

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Fast Plasma Investigation	GSFC	Provide plasma wave measurements (electric vector to 100 KHz).	Same Same	
Energetic Particle Detectors	JHU-APL	Provide high-resolution measurement of energetic particles.	Same Same	
Hot Plasma Composition Analyzers	Southwest Research Institute	Three-dimensional measurements of hot plasma composition (time resolution 10s).	Same Same	
Science Operations Center	University of Colorado/ Laboratory for Atmospheric and Space Physics	Provide science data to the community and archive.	Same Same	

Schedule Commitments

MMS began formulation in FY 2002. The project's confirmation review was held in June 2009 and the project was approved to enter implementation. As a result of the confirmation review, the launch date was moved to March 2015. The Mission Critical Design Review was successfully completed in August 2010.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Mission Definition Review	September 2007	September 2007	September 2007
Initial Confirmation Review	November 2007	November 2007	November 2007
Confirmation Review	June 2009	June 2009	June 2009
Critical Design Review	August 2010	August 2010	August 2010
System Integration review	January 2012	January 2012	January 2012
Launch	March 2015	March 2015	March 2015

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Heliophysics
Program: Solar Terrestrial Probes
MPAR Project In Development: MMS

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Magnetospheric Multiscale (MMS)	2010	857.4	2011	857.3	0	Launch Readiness	03/2015	03/2015	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**857.4**	**857.3**	**-0.1**
Payload	131.9	143.6	11.7
Spacecraft	169.0	182.1	13.1
Systems I&T	55.3	28.4	-26.9
Ground Systems	19.1	18.4	-0.7
Science/Technology	19.9	17.2	-2.7
Other (Project Management)	268.0	273.2	5.2
Launch Services	194.2	194.4	0.2

Project Management

The STP Program has program management responsibility for the MMS project.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Four Instrument Suites	GSFC, Southwest Research Institute	GSFC	Austrian Space Agency, France (CNES), and Japan (JAXA), Sweden (SNSB)
Launch Vehicle	KSC	KSC	None
Four Spacecraft	GSFC	GSFC	None
Mission Operations	GSFC	GSFC	None
Science Operations	GSFC, LASP	None	None

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Heliophysics**
Program:	**Solar Terrestrial Probes**
MPAR Project In Development:	**MMS**

Acquisition Strategy

The MMS spacecraft is being designed, developed, and tested in-house at GSFC using a combination of GSFC civil servants and local support service contractors. The acquisition of subcontracted spacecraft sub-assemblies, components, and parts is through procurement contracts issued by the MMS procurement office. Instrument development activities are under contract with SwRI. Instrument development subcontracts include Lockheed Martin, JAXA/MEISEI, University of New Hampshire, JHU-APL, Aerospace Corporation, and a team at GSFC. The Mission Operations Center and the Flight Dynamics Operations Area will be developed and operated at GSFC using a combination of GSFC civil servants and local support service contractors. The Science Operations Center for the instruments will be developed and operated at the Laboratory for Atmospheric and Space Physics at the University of Colorado and is under contract to SwRI.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
All SRB		08/2010	The Critical Design Review (CDR), an NPR 7120.5D review to assess the technical, cost, and schedule status of MMS. MMS was approved to proceed to manufacturing.	01/2012
All SRB		N/A	System Integration Review - Evaluate the readiness of the project to start flight system assembly, test, and launch operations.	03/2014
All SRB		N/A	Flight Readiness Review - Evaluate system assembly, integration, and test, preparing for the flight.	TBD

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Lunar Quest Program
MPAR Project In Development: LADEE

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**35.3**	**48.2**	**-**	**63.2**	**33.1**	**0.0**	**0.0**	**0.0**	**-**	**-**
FY 2011 Costs			62.9							
CSLE				8.5	11.1					
Administrative Labor Adjustments		.6								
2011 MPAR Project Cost Estimate	**35.3**	**48.8**	**62.9**	**71.7**	**44.2**	**0.0**	**0.0**	**0.0**	**0.0**	**262.9**
Formulation	35.3	44.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.5
Development	0.0	4.7	62.9	71.7	28.9	0.0	0.0	0.0	0.0	168.2
Operations	0.0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	0.0	15.2

- *Consistent with the August 23, 2010 KDP-C decision, funding for SOMD-sponsored Lunar Laser Communications Demonstration (LLCD), $65.3 million, is not included in the above number.*
- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

LADEE was confirmed to proceed into development phase on August 23, 2010, supporting a November 2013 launch date. The project's development and life cycle cost estimates and schedule in this document are consistent with the KDP-C memo and its baseline (NSPD 49) report.

Project Purpose

LADEE, the first mission developed within LQP, is a cooperative effort between ARC and GSFC. LADEE will address high-priority science goals, as identified by the NRC, that determine the global density, composition, and time variability of the fragile lunar atmosphere. LADEE's measurements will

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Lunar Quest Program
MPAR Project In Development: LADEE

also determine the size, charge, and spatial distribution of electrostatically transported dust grains. LADEE will carry an optical laser communications demonstrator to be provided by SOMD. The optical laser will technically demonstrate high-bandwidth communication from the lunar orbit.

Project Parameters

The LADEE spacecraft design is based on a reusable common bus concept, and will be the first spacecraft based on this bus design.

Project Commitments

The spacecraft is planned a near circular, lunar equatorial orbit at approximately 50 km. After launch in November 2013, science operations are planned for 100 days.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Spacecraft	NASA ARC	Small spacecraft based on reusable design	New	Same
Integrated Payload	NASA GSFC	3 science Instruments (UVS, NMS, LDEX)	New	Same
Launch Vehicle	U.S. Air Force's Orbital/Suborbital Program (OSP) Orbital Sciences Corporation	Medium Class/Minotaur V	New	Nomenclature of rocket (IV+ to V)

Schedule Commitments

SMD announced the LADEE project in April 2008 and assigned leadership of the mission to ARC. The LADEE project was confirmed to proceed into development phase on August 23, 2010, supporting a November 2013 launch date.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
KDP-C	08/23/2010	11/2010	08/23/2010
SIR	11/2012	N/A	11/2012
LRD/IOC/IC	11/2013	1/2013	11/2013
End of Prime Mission	03/2014	N/A	03/2014

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Lunar Quest Program
MPAR Project In Development: LADEE

Development Cost and Schedule Summary

The development estimate reflects the August 23, 2010 KDPC decision, which does not include $65M for the SOMD-sponsored Lunar Laser Communications Demonstration (LLCD).

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
LADEE	2011	168.2	2011	168.2	0	Launch Readiness	11/2013	11/2013	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**168.2**	**168.2**	**0.0**
Spacecraft	34.8	34.8	0.0
Payloads	15.0	15.0	0.0
Systems I&T	6.7	6.7	0.0
Launch Vehicle/Services	45.7	45.7	0.0
Ground Systems	3.5	3.5	0.0
Science/Technology	0.8	0.8	0.0
Other direct project cost	61.7	61.7	0.0

Project Management

LADEE operates under the LQP of the SMD Planetary Science Division. The decision authority is the SMD Associate Administrator.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Project Management	Overall, day-to-day management	ARC	N/A
Spacecraft	Design, build and deliver the spacecraft	ARC	N/A
Neutral Mass Spectrometer (NMS) Instrument	Design, build and deliver the NMS instrument. Also responsible for integrating of LDEX and UVS	GSFC	N/A

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Lunar Quest Program
MPAR Project In Development: LADEE

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
UV Spectrometer (UVS) Instrument	Design, build, and deliver	ARC	N/A
Lunar Dust EXperiment (LDEX) Instrument	Design, build, and deliver	University of Colorado, LASP	N/A
Launch Vehicle	Integrate vehicle and provide launch service	TBD N	/A

Acquisition Strategy

All major acquisitions are in place. The spacecraft bus was directed to ARC (UVS) in partnership with GSFC (NMS). LDEX was competitively selected through SALMON and awarded to the University of Colorado/LASP. The USAF Orbital/Suborbital Program and Orbital Sciences Corporation are providing the launch vehicle.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance SRB		07/2010	Reviewed implementation plan, technical readiness, schedule, costs. Passed Preliminary Design Review (PDR), and confirmed to proceed into implementation phase (C). Critical Design Review (CDR) will be the next independent review.	08/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Spacecraft design outgrows mass margin allocation	Spacecraft design may outgrow launch vehicle performance if alternative components are required in the spacecraft design as mass margins are extremely limited.	Mitigate through spacecraft design planning, including management of margins and contingencies per LADEE System Engineering Master Plan, carefully watch Min V performance margins through frequent updates from launch vehicle provider.
Minotaur V launch loads unknown	Delay of launch vehicle contract delayed coupled loads analysis which may impact CDR.	Coupled loads analysis is currently under contract for delivery immediately prior to CDR peer reviews. Small residual risk of short delay in CDR.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Discovery
MPAR Project In Development: GRAIL

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**221.2**	**124.1**	**-**	**40.5**	**4.4**	**0.0**	**0.0**	**0.0**	**-**	**-**
FY 2011 Costs			105.4							
CSLE				0.3	0.3					
2011 MPAR Project Cost Estimate	**221.2**	**124.1**	**105.4**	**40.8**	**4.7**	**0.0**	**0.0**	**0.0**	**0.0**	**496.2**
Formulation	50.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.6
Development	170.6	124.1	105.1	27.1	0.0	0.0	0.0	0.0	0.0	427.0
Operations	0.0	0.0	0.3	13.7	4.7	0.0	0.0	0.0	0.0	18.7

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*

Explanation of Project Changes

NASA confirmed GRAIL to proceed into implementation phase (KDP-C or Phase C/D) on January 28, 2009, and entered ATLO in July 2010. GRAIL approved baseline development ($427 million) and the LCC ($496.2 million) numbers remain unchanged since KDP-C.

Project Purpose

GRAIL was selected in December 2007 under the 2006 Discovery AO. The overarching scientific goal of the GRAIL mission is to determine the structure of the lunar interior from crust to core. The GRAIL mission will also advance our understanding of the thermal evolution of the Moon and extend our knowledge gained from the Moon to the other terrestrial-type planets.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Planetary Science**
Program:	**Discovery**
MPAR Project In Development:	**GRAIL**

GRAIL has six lunar science objectives:

- To map the structure of the crust and lithosphere;
- To study the moon's asymmetric thermal evolution;
- To determine the subsurface structure of impact basins and the origin and of masons (i.e., high-gravity areas);
- To study the temporal evolution of crustal brecciation, and magmatism;
- To study affect on the structure of the deep lunar interior from lunar tides; and
- To understand the size of the possible lunar inner core.

Project Parameters

GRAIL will achieve its science objectives by placing twin spacecraft in a nearly circular low altitude (50 km) polar orbit. The two spacecraft will perform high-precision range-rate measurements between them. Analysis of changes in the spacecraft-to-spacecraft range-rate data caused by gravitational differences will provide direct and high-precision measurements of the lunar gravity. GRAIL will ultimately provide a global, high-accuracy (<10 mGal), high-resolution (30 km) gravity map of the moon. The instrument is based on the successful Earth orbiting Gravity Recovery and Climate Experiment (GRACE) mission.

Project Commitments

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Flight System	Lockheed Martin	2 spacecraft with s/c separation of 175-225 km, conducting 90-day science phase	Same Same	
Lunar Gravity Ranging System	JPL	Ka-band ranging system determines the precise instantaneous relative range-rate of the two s/c	Same Same	
E/PO MoonKam	Sally Ride Science (SRS)	Taking images of the moon, the data will enrich the middle school space science education	Same Same	
Launch Vehicle	ULA	CLIN23 - Delta II Heavy	Same	Same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Discovery
MPAR Project In Development: GRAIL

Schedule Commitments

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Development (Phase C/D or KDP-C)	January 28, 2009	Same	Same
Critical Design Review (CDR)	November 2009	Same	Same
System Integration Review	June 2010	June 2010	Same
Launch Readiness Review	September 2011	Same	Same
End of Prime Mission	June 2012	Same	Same

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Gravity Recovery and Interior Laboratory	2009	427.0	2011	427.0	0	Launch Readiness	09/2011	09/2011	0

Development Cost Details

NASA confirmed GRAIL to proceed into implementation phase (KDP-C or Phase C/D) on January 28, 2009. GRAIL approved baseline development ($427 million) and the LCC ($496.2 million) estimates and schedule remain unchanged since KDP-C. Development Cost Details includes funding for CSLE/ULA.

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**427.0**	**427.0**	**0.0**
Payload	18.1	20.4	2.3
Spacecraft	133.3	157.0	23.7
Ground System	12.3	13.7	1.4
Science	10.8	11.1	0.3
Launch Vehicle	152.8	152.8	0.0
Other	99.7	72.0	-27.7

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Planetary Science**
Program:	**Discovery**
MPAR Project In Development:	**GRAIL**

Project Management

GRAIL is part of the Discovery program managed by MSFC. The PI from MIT has delegated day-to-day project management to JPL.

Acquisition Strategy

GRAIL was selected competitively on December 13, 2007, under a Discovery program AO (AO-NNH06ZDA001O).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance SRB/I	PAO	05/2010	Assess cost, schedule, and risk status of the project. The findings for the review showed that cost and schedule for the 2011 launch are consistent with the project's plans.	06/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Single String Spacecraft	Both GRAIL spacecraft are primarily single string for major components. If there is an in flight failure, then there is no ability to switch over to a total redundant component.	The mission is of relatively short duration and the single string risks are mitigated by use of proven designs, high reliability parts, and additional testing of critical systems, consistent with the cost and schedule constraints of the project.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: New Frontiers
MPAR Project In Development: Juno

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**485.9**	**257.1**	**-**	**31.2**	**17.6**	**17.9**	**16.7**	**29.6**	**-**	**-**
FY 2011 Costs			194.2							
CSLE				0.2	0.2	0.2	0.2	0.3		
2011 MPAR Project Cost Estimate	**485.9**	**257.2**	**194.2**	**31.4**	**17.8**	**18.1**	**16.8**	**29.9**	**55.7**	**1107.0**
Formulation	186.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	186.3
Development	299.6	257.2	178.5	7.0	0.0	0.0	0.0	0.0	0.0	742.3
Operations	0.0	0.0	15.7	24.4	17.8	18.1	16.8	29.9	55.7	178.4

- *Other than the rephasing adjustments, the project remains within its lifecycle ($1107M) and development ($742.3M) baseline cost estimates.*
- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*

Explanation of Project Changes

The funding profile has been modified consistent with NASA risk management plan and strategy. There are no changes to the Juno approved development ($742.3 million) nor the LCC ($1,107 million) baselines since KDP-C.

Project Purpose

NASA selected Juno on July 15, 2005, under the New Frontiers AO. The overarching scientific goal of the Juno mission is to improve understanding of the origin and evolution of Jupiter. However, as the archetype of giant planets, Jupiter can also provide knowledge that will improve understanding of both the origin of our solar system and of planetary systems being discovered around other stars. The investigation focuses on four science objectives.

Origin: Determine the oxygen-to-hydrogen ratio to determine water abundance and estimate core mass to decide among alternative theories of planetary origin.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Planetary Science**
Program:	**New Frontiers**
MPAR Project In Development:	**Juno**

Interior: Understand Jupiter's interior structure and dynamic properties through mapping of its gravitational and magnetic fields with unprecedented accuracy, leading to observations of internal convection and the size and mass of its core.

Atmosphere: Map variations in atmospheric composition, temperature, and cloud opacity and dynamics, to depths greater than 100 bars, at all latitudes.

Magnetosphere: Characterize and explore the three-dimensional structure of Jupiter's polar magnetosphere and auroras.

These objectives have been rated very highly in the National Academies' Solar System Exploration Decadal Survey and Sun-Earth Connections Decadal Survey. The Astrophysics decadal survey identified the study of star formation, their planetary systems, as well as giant and terrestrial planet birth and evolution as high priority. Juno fulfills key goals outlined in recent NASA and NRC studies.

Project Parameters

Juno achieves the science objectives by using a simple spinning, solar-powered spacecraft to make global maps of the gravity, magnetic fields, and atmospheric composition of Jupiter from a unique elliptical polar orbit with a close perijove. The spacecraft carries precise, high-sensitivity radiometers, magnetometers, and gravity science systems. Juno's 32 polar orbits extensively sample Jupiter's full range of latitudes and longitudes. From its polar perspective, Juno combines in-situ and remote sensing observations to explore the polar magnetosphere and determine the composition and phenomena of Jupiter's auroras.

Project Commitments

The Juno launch date is August 2011. After a five-year cruise to Jupiter, Juno will enter Jupiter Orbit Insertion (JOI) during August 2016. Juno will perform one year of science operations.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Waves	University of Iowa	Measures radio and plasma emissions; 4 m electric dipole and search coil	Same Same	
Jupiter Energetic particle Detector Instrument (JEDI)	John Hopkins Applied Physics Lab (JHU-APL)	Measures auroral distributions of electrons and ions; TOF vs. energy, and ion & electron sensors	Same Same	
Gravity Science	Jet Propulsion Lab (JPL)	Maps Jupiter's gravitational field to determine structure of core; X and Ka-band precision Doppler	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: New Frontiers
MPAR Project In Development: Juno

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Flux-Gate Magnetometer (FGM)	GSFC	Maps Jupiter's magnetic field (Vector)	Same Same	
Launch Vehicle	KSC	Atlas 551	Same	Same
UV Spectrometer (UVS)	Southwest Research Institute (SwRI)	FUV spectral imager for auroral emissions	Same Same	
Microwave Radiometer (MWR)	Jet Propulsion Lab (JPL)	6 wavelengths (1.3-50 cm); sounds atmosphere to determine water and ammonia abundances	Same Same	
Spacecraft	Lockheed Martin	Solar-powered, spin-stabilized spacecraft in an elliptical polar orbit that minimizes radiation exposure	Same Same	
Jovian Auroral Distributions Experiment (JADE)	Southwest Research Institute (SwRI)	Ion mass spectrometer and electron analyzers; measures auroral distributions of electrons and ions	Same Same	
Juno Camera (JunoCam)	Malin Space Studies Institute	EPO instrument that will take auroral images and Jovian atmospheric activity	Same Same	

Schedule Commitments

Formulation started at project selection in July 2005. Juno proceeded into the implementation phase on August 5, 2008, and entered ATLO in April 2010.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Formulation			
PDR	5/2008	same	same
Development			
CDR	3/2009	4/2009	same
SIR (formerly ATLO)	3/2010	same	4/2010
FRR 7/2011		same	same
Launch	8/2011	same	same
End of Prime Mission	10/2017	same	same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: New Frontiers
MPAR Project In Development: Juno

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Flux-Gate Magnetometer (FGM)	GSFC	Maps Jupiter's magnetic field (Vector)	Same	Same
Launch Vehicle	KSC	Atlas 551	Same	Same
UV Spectrometer (UVS)	Southwest Research Institute (SwRI)	FUV spectral imager for auroral emissions	Same	Same
Microwave Radiometer (MWR)	Jet Propulsion Lab (JPL)	6 wavelengths (1.3-50 cm); sounds atmosphere to determine water and ammonia abundances	Same	Same
Spacecraft	Lockheed Martin	Solar-powered, spin-stabilized spacecraft in an elliptical polar orbit that minimizes radiation exposure	Same	Same
Jovian Auroral Distributions Experiment (JADE)	Southwest Research Institute (SwRI)	Ion mass spectrometer and electron analyzers; measures auroral distributions of electrons and ions	Same	Same
Juno Camera (JunoCam)	Malin Space Studies Institute	EPO instrument that will take auroral images and Jovian atmospheric activity	Same	Same

Schedule Commitments

Formulation started at project selection in July 2005. Juno proceeded into the implementation phase on August 5, 2008, and entered ATLO in April 2010.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Formulation			
PDR	5/2008	same	same
Development			
CDR	3/2009	4/2009	same
SIR (formerly ATLO)	3/2010	same	4/2010
FRR	7/2011	same	same
Launch	8/2011	same	same
End of Prime Mission	10/2017	same	same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: New Frontiers
MPAR Project In Development: Juno

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
UVS and JADE instruments	JPL/Juno Project Office	JPL	None
Flight System, Integration and Test	Jet Propulsion Lab (JPL)	None	None
Overall responsibility for the development, implementation, operation, and success of the mission	MSFC/New Frontiers Program Office	None N	one
JunoCam	Jet Propulsion Lab (JPL)	None	None
KaBand and IR science	Jet Propulsion Lab (JPL)	None	Italian Space Agency (ASI)

Acquisition Strategy

All major acquisitions are in place. Juno was selected competitively on July 15, 2005 under the second New Frontiers program AO (AO-03-OSS-03).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance IPAO	/SRB	03/2010	Assess cost, schedule, and risk status of project. The findings from the review showed that cost and schedule for the August 2011 launch are consistent with the project's plans. The project received approval to proceed to ATLO.	06/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Jupiter Orbit Insertion	If Jupiter Orbit Insertion fails to put the spacecraft in the desired orbit, then science goals will not be obtainable.	Review baseline Phase E plan and compare with previously flown missions. Develop a recommended operational approach consistent with a Category 1, Class B mission to minimize the risk of an orbital insertion anomaly.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: Mars Science Lab

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	1744.4	258.4	-	136.43	40.5	37.0	0.0	0.0	-	-
FY 2011 Costs			254.9							
CSLE				1.5	1.5	1.5				
Administrative Labor Adjustments		0.1								
2011 MPAR Project Cost Estimate	1744.4	258.5	254.9	138.0	42.0	38.5	0.0	0.0	0.0	2476.3
Formulation	515.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	515.5
Development	1228.9	258.5	254.9	59.7	0.0	0.0	0.0	0.0	0.0	1802.0
Operations	0.0	0.0	0.0	78.3	42.0	38.5	0.0	0.0	0.0	158.8

- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
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- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Explanation of Project Changes

The project continues to make technical, cost, and schedule progress. The Sample Analysis of Mars (SAM) instrument has been delivered to the project and difficulties are being resolved for Sample Acquisition, Processing, and Handling (SA/SPaH) drill. To ensure mission success, NASA continues to adopt more conservative posture consistent with NASA risk management plan and strategy. The current life cycle cost is estimated at $2,476.3 million. NASA anticipates reprogramming additional funds to MSL in the initial FY 2011 operating plan to address the technical problems and related issues that have occurred during assembly and testing. The project remains on track to meet its November 2011 launch readiness date (LRD).

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	Planetary Science
Program:	Mars Exploration
MPAR Project In Development:	Mars Science Lab

Project Purpose

The Mars Science Laboratory (MSL) mission is the most technologically challenging interplanetary rover ever designed. It will use new technologies to adjust its flight while descending through the Martian atmosphere, and to set the rover on the surface by lowering it on a tether from a hovering descent stage. Advanced research instruments make up a science payload ten times the mass of instruments on NASA's Spirit and Opportunity Mars rovers. MSL is engineered to drive longer distances over rougher terrain than previous rovers. It will also employ a new surface propulsion system.

MSL will make detailed measurements of element composition, elemental isotopes and abundance, mineralogy, and organic compounds to determine if Mars has, or ever had an environment capable of supporting life within the regions explored by MSL.

MSL has four science objectives:
- Assess the biological potential of at least one selected site on Mars;
- Characterize the geology and geochemistry of the landing region at all appropriate spatial scales;
- Identify planetary processes relevant to past habitability; and
- Characterize the broad spectrum of the Martian surface radiation environment.

For more information, see the MSL homepage at
http://marsprogram.jpl.nasa.gov/missions/future/msl.html.

Project Parameters

The MSL is a surface rover that will collect Martian soil and rock samples and analyze them for organic compounds and environmental conditions that could have supported microbial life now or in the past. MSL will be a long-duration (two years) roving science laboratory that will be twice as long and four times as heavy (900 kilograms) as the Mars Exploration Rovers, Spirit and Opportunity.

Key technologies developed for MSL include: throttle-controlled, high-thrust engines, required during Martian entry, descent, and landing (EDL); sample acquisition and processing equipment used to acquire and distribute samples to the analytic instrument suite; and long-life, high-reliability, thermal-cycle-resistant electronics for use in the rover.

The EDL system will accommodate a wide range of possible latitude and altitude locations on Mars in order to be discovery-responsive and to have the capability to reach very promising, but difficult-to-reach scientific sites.

Project Commitments

The MSL will be ready to launch in November 2011 and will arrive at Mars approximately nine months (August 2012) later. MSL will operate for two Earth years on the surface of Mars and will travel approximately 20 kilometers on the Martian surface.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: Mars Science Lab

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Rover	JPL	Travel 20 kilometers over the Martian surface.	Same Same	
Stereoscopic and microscopic cameras	Malin Space Systems	Acquire color, stereo images with resolutions up to 0.2 mm/pixel at 2 m range.	Same	Added MastCam zoom capability
Robotic arm tools	Honeybee Robotics	Acquire, process and deliver 75 rock and soil samples to analytic instruments.	Changed the rock grinder to a brush, sample quantity unchanged acquired by drill.	Same
Chemistry camera (ChemCam)	Department of Energy/Los Alamos National Laboratory; France	Remotely measure elemental composition of rocks and soil up to 9m from rover.	Same Same	
Alpha Particle X-ray Spectrometer	Canada (CSA)	Measure with high precision the elemental composition of in situ rocks and soil.	Same Same	
Rover Environmental Monitoring System (REMS)	Spain	Monitor key atmospheric measurements including temperature, pressure, wind speed/direction and humidity.	Same Same	
Dynamic Albedo of Neutrons (DAN)	Russia (IKI)	Measure hydrogen content in subsurface deposits.	Same Same	
Cruise stage and entry system	Lockheed Martin	Transport rover to Martian surface and land with impact speed below 1 m/s	Same Same	
Mission operations and data archive	JPL	Conduct one-year cruise and two-year rover primary mission with remotely located science team.	Same Same	
Sample Analysis at Mars (SAM)	NASA/GSFC	Analysis of elemental and isotopic composition of Mars samples	Same Same	
Sample Cache	ARC	Hockey puck-sized container will collect sample of Martian soil for possible later collection by a Mars sample return mission.	Deleted Same	
Chemistry and Mineralogy Instrument (CheMin)	NASA/ARC	Analysis of mineral and chemical content of Mars samples	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: Mars Science Lab

Schedule Commitments

The MSL entered formulation phase in November 2004 and proceeded into implementation phase in August 2006. The project is currently scheduled for launch in November 2011, to be followed by landing and surface science operations beginning in August 2012.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Critical Design Review	June 2007	June 2007	Same
System Integration Review (formerly ATLO)	February 2008	February 2008	Same
Launch Readiness Review	September 2009	4QTR CY 2011	Same

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
2009 Mars Science Lab	2010	1,719.9	2011	1,802.0	5	Launch Readiness	11/2011	11/2011	0

Development Cost Details

The table below reflects a revised estimate to accommodate technical and cost risks as approved in the December 2011 APMC.

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**1,719.9**	**1,802.0**	**82.1**
Spacecraft	930.9	1,034.1	103.2
Payloads	130.3	155.0	24.7
Systems I&T	89.9	107.7	17.8
Launch Vehicle/Services	232.8	234.0	1.2
Ground Systems	74.2	78.2	4.0
Science/Technology	15.9	15.6	-0.3
Other direct project cost	245.9	177.4	-68.5

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: Mars Science Lab

Project Management

MSL is a JPL-managed in-house project. Instrument implementation has been assigned to JPL.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Rover	JPL	JPL	None
Stereoscopic and microscopic cameras	JPL	None	None
Robotic arm tools	JPL	JPL	None
Chemistry camera (ChemCam)	JPL	None	Department of Energy and France
Alpha Particle X-ray Spectrometer	JPL	None	Canada
Rover Environmental Monitoring System (REMS)	JPL	None	Spain
Dynamic Albedo of Neutrons (DAN)	JPL	None	Russia
Cruise stage and entry system	JPL	JPL, AMES, LaRC	None
Spacecraft	JPL	JPL	None
Sample Analysis at Mars (SAM)	JPL GSF	C	CNES (France)
Chemistry and Mineralogy Instrument (CheMin)	JPL AR	C	None

Acquisition Strategy

All major acquisitions are in place. All major instruments were competitively selected. Malin Space Systems, Honeybee Robotics, Lockheed Martin, and Aeroflex are providing support and hardware for the MSL mission.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: Mars Science Lab

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance HQ/SRB		11/2010	Assess maturity of MSL design, technical state, and adequacy of resources. Design was deemed adequate to achieve mission science goals, but project needs additional time and resources to work the technical problems and perform adequate testing. The finding resulted in an additional $82.11 million, consistent with NASA risk management plan and strategy, to resolve problems and to ensure mission success.	03/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
MSL Landing Risk	If the MSL spacecraft does not successfully land on the Martian surface, then the science objectives will not be achieved.	To ensure success, conduct thorough verification and validation program that includes simulations of trajectory, approach, and landing operations to validate and refine procedures, and apply lessons learned from Phoenix and MER.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: MAVEN

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**9.9**	**48.1**	**-**	**240.3**	**140.6**	**34.9**	**15.4**	**4.7**	**-**	**-**
FY 2011 Costs			160.6							
CSLE				5.4	5.8	2.7	1.9	0.5		
Administrative Labor Adjustments		0.3								
2011 MPAR Project Cost Estimate	**9.9**	**48.4**	**160.6**	**245.7**	**146.4**	**37.6**	**17.3**	**5.3**	**0.0**	**671.2**
Formulation	9.9	48.4	5.5	0.0	0.0	0.0	0.0	0.0	0.0	63.9
Development	0.0	0.0	155.0	245.7	146.4	20.1	0.0	0.0	0.0	567.2
Operations	0.0	0.0	0.0	0.0	0.0	17.5	17.3	5.3	0.0	40.1

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Explanation of Project Changes

MAVEN received KDP-C decision approval on October 4, 2010. The above funding estimate reflects the October 2010 KDP-C decision, which included Electra and the awarded launch vehicle costs.

Project Purpose

Mars Atmosphere and Volatile EvolutioN (MAVEN) was selected in September 2008 under the 2006 Mars Scout AO. The MAVEN mission will provide a comprehensive picture of the Mars upper atmosphere, ionosphere, solar energetic drivers, and atmospheric losses. MAVEN will deliver answers to long-standing questions regarding the loss of Mars' atmosphere, climate history, liquid water, and habitability. MAVEN will provide the first direct measurements ever taken to address key scientific questions about Mars' evolution.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**Planetary Science**
Program:	**Mars Exploration**
MPAR Project In Development:	**MAVEN**

Specific MAVEN science objectives are to:

- Determine structure and composition of the atmosphere and ionosphere;
- Determine the physical and chemical processes that control loss processes;
- Determine escape rates of neutrals;
- Determine escape rates of ions;
- Determine the external inputs that control upper atmosphere and ionosphere structure and that drive escape; and
- Determine the relative escape rates of the stable isotopes and the resulting isotopic fractionation.

Additional information can be found at http://www.nasa.gov/maven.

Project Parameters

MAVEN will deliver its science using three instrument packages: a stand-alone neutral gas and ion mass spectrometer (NGIMS), capable of measuring thermal neutrals and ions; a stand-alone imaging ultraviolet spectrometer (IUVS); and the Particles and Fields package, consisting of six instruments measuring ionospheric properties, energetic ions, solar wind and solar energetic particles, magnetic fields, and solar extreme ultraviolet irradiance.

Project Commitments

The MAVEN measurements will be made from an elliptical orbit with periapsis at 150 km and apoapsis at 6220 km (4.5-hour period). MAVEN will use a sun-pointing, three-axis stabilized spacecraft, with a two-axis gimballed, Mars-pointing platform for the NGIMS, IUVS, and the SupraThermal And Thermal Ion Composition (STATIC) instruments. The spacecraft has a body-mounted high-gain antenna.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Launch Services	United Launch Services	Atlas V Launch Service	New	Same (reported as intermediate class launch service; Atlas V now selected)
Spacecraft	Lockheed Martin	MRO-heritage spacecraft bus and avionic suite, with cross strapping and monopropellant propulsion system	New Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: MAVEN

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Neutral Gas and Ion Mass Spectrometer (NGIMS)	GSFC	Mass Spectrometry Instrument	New Same	
Supra Thermal and Thermal Ion Composition (STATIC)	SSL	Part of the MAVEN particle and fields instrument package	New Same	
Solar Energetic Particles (SEP)	SSL	Part of the MAVEN particle and fields instrument package	New Same	
Solar Wind Electron Analyzer (SWEA)	SSL	Part of the MAVEN particle and fields instrument package	New Same	
Solar Wind Ion Analyzer (SWIA)	SSL	Part of the MAVEN particle and fields instrument package	New Same	
Lanamuir Probe and Waves and EUV (LPW/EUV)	LASP	Part of the MAVEN particle and fields instrument package	New Same	
Magnetometer GSF	C	Part of the MAVEN particle and fields instrument package	New Same	
Imaging Ultraviolet Spectrometer (IUVS)	LASP	Remote-Sensing Instrument package	New Same	
Electra	JPL	UHF Data Relay payload	New	Same

Schedule Commitments

NASA selected the second Mars Scout mission, MAVEN, for formulation on September 15, 2008. MAVEN was confirmed to proceed into implementation phase on October 4, 2010, with a November 2013 launch date and arrival at Mars in September 2014.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Formulation			
PDR 07/20	10	New	Same
Development			
CDR 07/20	11	New	Same
ATLO 07/20	12	New	Same
Launch 11/20	13	New	Same
Mars Orbit Insertion	09/2014	New	Same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: MAVEN

Development Cost and Schedule Summary

Project	Base Year	Base Year Development Cost Estimate ($M)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
Mars Atmosphere & Volatile EvolutioN	2011	567.2	2011	567.2	0	LRD	11/2013	11/2013	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**567.2**	**567.2**	**0.0**
Spacecraft	146.0	146.0	0.0
Payload(s)	51.1	51.1	0.0
Systems I&T	23.0	23.0	0.0
Launch Vehicle/Services	187.0	187.0	0.0
Ground Systems	5.2	5.2	0.0
Science/Technology	2.2	2.2	0.0
Other Direct Project Cost (w/project and HQ held UFE and ULA UFE)	152.7	152.7	0.0

Project Management

The MAVEN project is part of the Mars Exploration Program managed for NASA by the Mars Program Office at JPL. The PI for MAVEN is from the University of Colorado and has delegated the day-to-day management of the MAVEN Project to GSFC.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Project management, mission systems engineering, safety and mission assurance, and project scientist	GSFC GSFC		
Neutral gas and ion mass spectrometer (NGIMS)	GSFC GSFC		

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: Planetary Science
Program: Mars Exploration
MPAR Project In Development: MAVEN

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Navigation, trajectory, and orbit maintenance analysis	GSFC	JPL	
Magnetometer (MAG) - Measures interplanetary, solar wind, and ionospheric magnetic fields	GSFC	GSFC	
Payloads	GSFC	GSFC	CNES
Spacecraft	GSFC		
Mission Operations	GSFC		
Launch Vehicle	KSC	KSC	
Ground Systems	GSFC		
Systems Integration and Testing	GSFC	GSFC	
E/PO	HQ	GSFC	
Science	HQ	GSFC	

Acquisition Strategy

All major acquisitions are in place. MAVEN was selected competitively on September 15, 2008, under the Mars Scout 2006 Announcement of Opportunity (AO-NNH06ZDA002O).

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance	SRB	07/2010	The MAVEN Project passed the Preliminary Design Review (PDR)/Non-Advocacy Review (NAR) conducted by the independent Standing Review Board in July 2010.	07/2011

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
Single Point Failures on High Efficiency Power Supply (HEPS) Card	If single point failures on the input of the HEPS card occur, then permanent loss of spacecraft electrical power will result.	The project and Goddard Mission Assurance Office are identifying and understanding HEPS-specific manufacturing techniques; identifying all single point failures to inspect during assembly to mitigate against shorts; developing a plan for insight/oversight of the MAVEN-specific HEPS card build; and reviewing board requirements with an eye towards design robustness and remaining design requirements.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: James Webb Space Telescope
Program: James Webb Space Telescope
MPAR Project In Development: James Webb Space Telescope

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**2,552.30**	**438.7**	**-**	**354.87**	**359.35**	**365.26**	**371.60**	**371.62**	**-**	**-**
FY 2011 Costs			444.8							
CSLE				19.1	15.7	9.7	3.4	3.4		
Administrative Labor Adjustments		1.1								
CoF Adjustments		21.6	26.5	1.0						
2011 MPAR Project Cost Estimate	**2,552.3**	**461.4**	**471.3**	**375.0**	**375.0**	**375.0**	**375.0**	**375.0**	**TBD**	**TBD**

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- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*
- *The row titled "CoF Adjustments" reflects the transfer of programmatic CoF (Construction of Facilities) to the Construction and Environmental Compliance and Restoration (CECR) account.*

Explanation of Project Changes

During 2010, JWST identified cost growth and schedule issues, which resulted in the formation of the ICRP. The ICRP charter was to determine the technical, management, and budgetary root causes of cost growth and schedule delay on JWST, to estimate the minimum cost to launch JWST, and to assess the associated launch date and budget profile. The ICRP report concluded that the problems causing cost growth and schedule delays on the JWST project are primarily associated with cost estimation and program management. The panel recommended several managerial changes at Headquarters and GSFC and some of these have already been implemented. The schedule for completing the JWST project within the budget provided will be re-evaluated as part of a replanning activity and a new plan is expected in 2011. The results of this re-planning activity will be presented to Congress immediately upon completion of the work. In addition, NASA will keep Congress apprised of progress during development of the new baseline.

MPAR BASELINE & COST ESTIMATES	
Mission Directorate:	Science
Theme:	James Webb Space Telescope
Program:	James Webb Space Telescope
MPAR Project In Development:	James Webb Space Telescope

As indicated in NASA's letter to Congress on October 28, 2010, it is certain that the JWST baseline development cost and launch readiness date will be exceeded by more than 15 percent and six months.

Project Purpose

JWST is a large, deployable, space-based infrared astronomical observatory. The mission is a logical successor to the Hubble Space Telescope (HST), extending beyond Hubble's discoveries by looking into the infrared spectrum, where the highly red-shifted early universe must be observed, where cool objects like protostars and protoplanetary disks emit infrared light strongly, and where dust obscures shorter wavelengths.

The four main science goals are to:

- Search for the first galaxies or luminous objects formed after the Big Bang;
- Determine how galaxies evolved from their formation until now;
- Observe the formation of stars from the first stages to the formation of planetary systems; and
- Measure the physical and chemical properties of planetary systems and investigate the potential for life in those systems.

Hubble has greatly improved knowledge about distant objects, but its infrared coverage is limited. Light from distant galaxies is redshifted by the expansion of the universe into the infrared part of the spectrum (from the visible). By examining light redshifted beyond Hubble's sight, JWST will be able to observe things farther away, as their light has taken longer to reach us. Hence it will be looking back further in time.

JWST will explore the mysterious epoch when the first luminous objects in the universe came into being after the Big Bang. The focus of scientific study will include first light of the universe, assembly of galaxies, origins of stars and planetary systems, and origins of the elements necessary for life.

The telescope will launch from Kourou, French Guiana, on a ESA-supplied Ariane 5 rocket. Its operational location is the L2 point, which is about one million miles from the Earth.

For more information, please see: http://www.jwst.nasa.gov.

Project Parameters

JWST will be optimized for infrared astronomy, with some capability in the visible range. JWST's instruments are the Near Infrared Camera (NIRCam), MIRI, NIRSpec, and the Fine Guidance Sensor (FGS).

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**James Webb Space Telescope**
Program:	**James Webb Space Telescope**
MPAR Project In Development:	**James Webb Space Telescope**

NIRCam is an imager with a large field of view and high angular resolution. It covers a wavelength range of 0.6 - 5 micrometers and has 10 mercury-cadmium-telluride (HgCdTe) detector arrays. These are analogous to charge coupled devices found in ordinary digital cameras. NIRCam is a science instrument but also a wavefront sensor, which is used to align and focus the optical telescope.

NIRSpec enables scientists to obtain simultaneous spectra of more than 100 objects in a 9-square-arcminute field of view. It provides medium-resolution spectroscopy over a wavelength range from 0.6 - 5 micrometers. NIRSpec employs a micro-electromechanical system "microshutter array" for aperture control, and it has two HgCdTe detector arrays.

MIRI is an imager/spectrograph that covers the wavelength range of 5 - 28 micrometers and it has three arsenic-doped silicon detector arrays. The camera module provides wide-field broadband imagery, and the spectrograph module provides medium-resolution spectroscopy over a smaller field of view compared to the imager. The nominal operating temperature for MIRI is 7 degrees above absolute zero, which is possible through an on-board cooling system.

The FGS is a guider camera that is incorporated into the instrument payload in order to meet the image motion requirements of JWST. This sensor is used for both guide star acquisition and fine pointing. The sensor operates over a wavelength range of 1 - 5 micrometers and has two HgCdTe detector arrays. Its field of view provides a 95 percent probability of acquiring a guide star for any valid pointing direction. The FGS tunable filter camera is a wide-field, narrow-band camera that provides imagery over a wavelength range of 1.6 - 4.9 micrometers, via tunable Fabry-Perot etalons that are configured to illuminate the detector array with a single order of interference at a user-selected wavelength. The camera has a single HgCdTe detector array.

The JWST ground operations, Science Support Center, and archives will be at the Space Telescope Science Institute in Baltimore, MD.

Project Commitments

After launch, JWST will complete six months of on-orbit checkout and commissioning and five years of prime mission operations. JWST has a goal of 10 years of operations.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Observatory	Northrop Grumman Aerospace Systems, Redondo Beach, California	Includes Optical Telescope Element (OTE), Spacecraft, Sunshield, Observatory AI&T and commissioning. The Observatory shall be designed for at least a 5-year lifetime.	Same Same	

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: James Webb Space Telescope
Program: James Webb Space Telescope
MPAR Project In Development: James Webb Space Telescope

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
Integrated Science Instrument Module (ISIM)	NASA Goddard Space Flight Center	Contains the Science Instruments (SIs) and Fine Guidance Sensor (FGS). Provides structural, thermal, power, command and data handling resources to the SIs and FGS.	Same Same	
Near-Infrared Camera (NIRCam) instrument	University of Arizona; Lockheed Martin	Optimized for finding first light sources, and operating over the wavelength range 0.6-5 microns.	Same Same	
Near-Infrared Spectrometer (NIRSpec)	European Space Agency (ESA)	Operating over the wavelength range 0.6-5 microns with three observing modes.	Same Same	
Mid-Infrared Instrument (MIRI)	ESA; University of Arizona; Jet Propulsion Laboratory	Operating over the wavelength range 5-27 microns, providing imaging, coronagraphy, and spectroscopy.	Same Same	
Fine Guidance Sensor	Canadian Space Agency (CSA)	Provides scientific target pointing information to the observatory's attitude control sub-system.	Same Same	
Launch Vehicle	European Space Agency (ESA)	Ariane V ECA	Same	Same
Science Operations Center and Mission Operations	Space Telescope Science Institute (STScI)	Mission Operations and Science Operations Center	Same Same	

Schedule Commitments

JWST was approved to enter implementation in July 2008 and completed CDR in April 2010.

The JWST project schedule, given the budget provided, is being re-evaluated as part of a re-planning activity and a new plan is expected in 2011. The results of this re-planning activity will be presented to Congress immediately upon completion of the work. In addition, NASA will keep Congress apprised of progress during development of the new baseline.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: James Webb Space Telescope
Program: James Webb Space Telescope
MPAR Project In Development: James Webb Space Telescope

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
Non-Advocate Review/Preliminary Design Review	March, 2008	Same	Same
Start phase C/Implementation	July 2008	Same	Same
Critical Design Review	April 2010	Same	Same
Systems Integration Review (SIR)	May 2012	February 2013	TBD
Launch Readiness Date	June 2014	Same	TBD
Start Phase E	December 2014	Same	TBD

Development Cost and Schedule Summary

Note: A current year cost and schedule estimate for JWST is being developed as part of the replanning activity which will be completed in 2011.

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
James Webb Space Telescope	2009	2,581.1	2011	TBD	TBD	Launch	06/2014	TBD	TBD

Development Cost Details

The JWST project development cost breakout is being developed as part of the replanning activity which will be completed in 2011.

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**2,581.1**	TBD	TBD
Payload	178.4	TBD	TBD
Spacecraft	875.4	TBD	TBD
Systems I&T	67.3	TBD	TBD
Ground Systems	206.8	TBD	TBD
Science/technology	10.5	TBD	TBD
Other (launch services and project management)	1,242.7	TBD	TBD
Programmatic Construction of Facilities (transferred to Construction appropriation)	0.0	TBD	TBD

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Science
Theme: James Webb Space Telescope
Program: James Webb Space Telescope
MPAR Project In Development: James Webb Space Telescope

Project Management

Goddard Space Flight Center is responsible for JWST project management.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
Observatory	GSFC	GSFC	None
Mission management and System Engineering	GSFC	GSFC	None
Integrated Science Instrument Module (ISIM)	GSFC	GSFC	None
NIRCam	GSFC	GSFC	None
NIRSpec	ESA	None	ESA
MIRI	GSFC	JPL, ARC	ESA
Fine Guidance Sensor - Tunable Filter (FGS-TF)	CSA	None	CSA
Ariane 5 ESA launch vehicle and launch operations	ESA	None	ESA
Ground control systems and science operations and control center	GSFC	None	None

Acquisition Strategy

JWST is being built by Northrop Grumman Aerospace Systems (Redondo Beach, CA), with major subcontractors including Ball Aerospace (Boulder, CO), ITT (Rochester, NY), and Alliant Techsystems (Edina, MN). Selections were made via a NASA request for proposal.

The Space Telescope Science Institute (STScI), in Baltimore, MD, is developing the Science and Operations Center and associated services.

The Integrated Science Instrument Module (ISIM) is being provided by GSFC.

The University of Arizona at Tucson is providing NIRCam, along with Lockheed Martin's Advanced Technology Center in Palo Alto, CA. The selection was made via a NASA announcement of opportunity.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**James Webb Space Telescope**
Program:	**James Webb Space Telescope**
MPAR Project In Development:	**James Webb Space Telescope**

ESA is providing MIRI, with management and technical participation by ARC and JPL. ARC and JPL were selected for this role after an internal NASA competition. ESA is also providing NIRSpec and an Ariane 5 launch vehicle.

The Canadian Space Agency is providing the Fine Guidance Sensor.

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Performance SRB		04/2010	Critical Design Review. SRB found that mission design is mature and recommended a more in depth review of the integration and testing plan.	TBD
Quality	Test Assessment Team	08/2010	The TAT evaluated JWST plans for integration and testing. The TAT recommended several changes to the test plan. See the full report at http://www.jwst.nasa.gov/publications.html.	n/a
Other	Independent Comprehensive Review Panel	10/2010	The ICRP charter was to determine the technical, management and budgetary root causes of cost growth and schedule delay on JWST, and estimate the minimum cost to launch JWST, along with the associated launch date and budget profile, including adequate reserves. The report made 22 recommendations covering several areas of management and performance.	n/a
Performance	SRB	N/A	Systems Integration Review	TBD
Performance	SRB	N/A	Flight Readiness Review	TBD

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
JWST Cost and Schedule Growth	Projected FY 2011 ISIM and Northrop Grumman Aerospace Systems cost growth will exceed available budget, resulting in a work delay, and delaying the LRD. Inclusion of SRB-recommended verification enhancements will further impact cost and schedule.	Project replan is underway and will be complete in 2011.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Science**
Theme:	**James Webb Space Telescope**
Program:	**James Webb Space Telescope**
MPAR Project In Development:	**James Webb Space Telescope**

Title	Risk Statement	Risk Management Approach and Plan
JWST Sunshield Deployment	If the sunshield fails to deploy to its prescribed operational shape then mission science requirements cannot be met.	Full-scale deployment demonstration test bed will be used to verify all deployment designs. Extensive deployment testing will be conducted at temperature of all sunshield assemblies and components.

Corrective Action Plan (as submitted in Report on Program and Cost Assessment January 11, 2011 – as required under 1203)

NASA is undertaking multiple actions to correct the problems that resulted in the identified JWST cost and schedule issues. A detailed report of these actions is provided in NASA's detailed response to the recommendations of the Independent Comprehensive Review Team, provided to Congress separately. Changes already made include restructuring management and changing personnel at both NASA Headquarters and GSFC. In addition, the Headquarters Science Mission Directorate (SMD) is moving rapidly to provide rigorous, independent assessments of cost and schedule performance. SMD is arranging for experienced personnel to be dedicated to JWST cost and schedule analysis for the duration of JWST development. These personnel will report to the new JWST Program Director at NASA Headquarters. Moreover, utilizing the new management structure personnel and processes, the project is developing a revised cost and schedule baseline, to be completed, reviewed independently, and approved in 2011. NASA will keep Congress apprised of progress during development of the new baseline.

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Space Operations Mission Directorate
Theme: Space and Flight Support (SFS)
Program: Space Communications and Navigation
MPAR Project In Development: TDRS Replenishment

2011 MPAR Project Cost Estimate

Budget Authority ($ millions)	Prior	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	BTC	LCC TOTAL
FY 2012 President's Budget Request	**369.0**	**25.4**	**-**	**1.0**	**11.4**	**0.0**	**0.0**	**0.0**	**-**	**-**
FY 2011 Costs			19.0							
CSLE				4.1	2.3					
Administrative Labor Adjustments		0.6								
2011 MPAR Project Cost Estimate	**370.3**	**26.0**	**19.0**	**5.1**	**13.7**	**0.0**	**0.0**	**0.0**	**0.0**	**434.1**
Formulation	241.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241.9
Development	128.4	26.0	19.0	5.1	13.7	0.0	0.0	0.0	0.0	192.2
Operations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

- *$1.3 difference in Prior accounts for FY 2006 expenditures under the Space Communications project, which was the initialization of TDRS Replenishment project.*
- *Space flight projects, per NASA's policy, are baselined and then budgeted to a confidence level of 70%. This confidence level is reflected in the project's estimated Life Cycle Cost Estimate (LCCE) at key decision point C.*
- *The row titled "FY 2012 President's Budget Request" is the equivalent of the same row in the Project in Development pages.*
- *The row titled "FY 2011 Costs" is the project's cost estimate for that year based on the 2010 Authorization Act as a guide for planning purposes. The FY 2011 appropriation for NASA was not enacted at the time that the FY 2012 Request was prepared; therefore, NASA is operating under a Continuing Resolution (P.L. 111-242, as amended).*
- *The row titled "CSLE" reflects the civil service labor and expenses (CSLE) in FY 2012 and beyond. CSLE funds are administered within a single consolidated account in each of the appropriations, and not allocated within the project's FY 2012 President's Budget Request amounts. CSLE funds are included in the projects' cost estimates (a full cost view).*
- *The row titled "Administrative Labor Adjustments" represents administrative costs in FY 2010 that transferred out of the project budget lines into the Center Management and Operations account. Administrative labor was defined as all civil servants not classified as scientists, engineers, mathematicians, medical, or quality assurance. These costs are included in the project LCCE.*

Project Purpose

The existing TDRSS fleet supports tracking, data, voice, and video services to the ISS, space and Earth science missions, as well as other Government agency users. The total mission load is predicted to increase, which will require additional satellites to be added to the fleet. The existing fleet is aging and reliability analyses predict a shortage of flight assets to support NASA missions and the user community by FY 2011. To meet this requirement, in FY 2007, NASA began the acquisition of two additional spacecraft, TDRS-K and TDRS-L. TDRS-K is scheduled to be launched in December 2012, although NASA is evaluating the possibility of launching as early as April 2012. TDRS-L is scheduled for launch in December 2013. By adding these two spacecraft to the TDRSS fleet, continuity of service will be insured for NASA and other Government agency user missions through at least FY 2016. The

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Space Operations Mission Directorate**
Theme:	**Space and Flight Support (SFS)**
Program:	**Space Communications and Navigation**
MPAR Project In Development:	**TDRS Replenishment**

TDRS Replenishment project supports future Agency requirements and technology initiatives consistent with the approved baseline of the SCaN architecture.

Project Parameters

TDRSS consists of in-orbit telecommunications satellites stationed at a geosynchronous altitude with associated ground stations located at White Sands and Guam. This system of satellites and ground stations is SN providing services for near-Earth user satellites and orbiting resources. SN supports spacecraft that depend on it for reliable services to continue their missions. The TDRSS constellation includes first and the second generation satellites.

Project Commitments

The TDRS-K and TDRS-L spacecraft will be fully compatible and capable of functioning as a part of the existing TDRSS. Contract requirements are design, development, fabrication, integration, test, on-orbit acceptance, and launch vehicle and services. Launch dates for TDRS-K and TDRS-L are in December 2012 (or possibly as early as April 2012) and December 2013, respectively. The spacecraft are required to have an operational life of 11 years. The basic requirement will also include modification of the White Sands SGLT to provide compatibility with the new spacecraft.

Project Element	Provider	Description	FY 2011 PB Request	FY 2012 PB Request
TDRS Replenishment	NASA	Aging hardware replacement	Same Same	

Schedule Commitments

The TDRS Replenishment project was approved for entry into Phase C, development, in July 2009. The launch vehicle and payload will be delivered to KSC for processing to meet the TDRS-K and TDRS-L launch dates.

Milestone Name	Confirmation Baseline	FY 2011 PB Request	FY 2012 PB Request
Development			
TDRS System Critical Design Review (CDR)	January 2010	N/A	Same
TDRS Systems Integration Review (SIR)	January 2011	N/A	Same
TDRS Flight Readiness Review (FRR)	November 2012	N/A	Same
TDRS K Launch Readiness Date (LRD)	December 2012	N/A	Same
TDRS L Launch Readiness Date (LRD)	December 2013	N/A	Same

MPAR BASELINE & COST ESTIMATES

Mission Directorate: Space Operations Mission Directorate

Theme: Space and Flight Support (SFS)

Program: Space Communications and Navigation

MPAR Project In Development: TDRS Replenishment

Development Cost and Schedule Summary

Project	Base Year	Base Year Develop-ment Cost Estimate ($M)	Current Year	Current Year Develop-ment Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
TDRS Replenishment	2010	209.4	2011	192.2	-8	LRD	12/2013	12/2013	0

Development Cost Details

Element	Base Year Development Cost Estimate ($M)	Current Year Development Cost Estimate ($M)	Delta
Total:	**209.4**	**192.2**	**-17.2**
Aircraft/Spacecraft	56.7	71.7	15
Ground Systems	53.7	53.7	0
Other Direct Project Cost	99.0	66.8	-32.2

Project Management

The Deputy Associate Administrator for SCaN reports to the Associate Administrator for Space Operations at NASA Headquarters.

Project Element	Project Management Responsibility	NASA Center Performers	Cost-Sharing Partners
TDRS Replenishment	Space Communications and Navigation (SCAN) Program Office - NASA Headquarters	Goddard Space Flight Center, Kennedy Space Center	US Government Agencies

Acquisition Strategy

The TDRS K and L project is providing follow-on and replacement spacecraft necessary to maintain and expand the Space network. The contract to build two additional TDRS spacecraft was awarded to Boeing Satellite Systems in December 2007. In addition to building the TDRS K and L spacecraft, the contract also includes the modifications to the White Sands Complex ground system required to support these new spacecraft. The contract also provides fixed price options to procure two additional satellites, and NASA is using the TDRS reliability model -- in consultation with TDRS users -- to assess future requirements for the TDRS constellation and determine whether the Government needs to exercise the options.

MPAR BASELINE & COST ESTIMATES

Mission Directorate:	**Space Operations Mission Directorate**
Theme:	**Space and Flight Support (SFS)**
Program:	**Space Communications and Navigation**
MPAR Project In Development:	**TDRS Replenishment**

Project Risk Management

Title	Risk Statement	Risk Management Approach and Plan
TDRS-K and TDRS-L Obsolescence Risk Management	Aging spacecraft requires replacement hardware by FY 2013. The mission load is predicted to exceed current capacity and will need additional spacecraft to provide enough capacity.	The project has awarded a firm fixed price with incentive fee contract as of December 2007 to Boeing Satellite Systems, Inc. Spacecraft will launch in December 2012 and December 2013, respectively.

NASA's FY 2011 and FY 2012 Annual Performance Plans

NASA's 2011 Strategic Plan unveils the Agency's new direction and new strategic goals. NASA has updated its annual performance plans (APPs) to reflect this new direction. In concert with this effort, NASA is transitioning to a new performance framework with a focus on increased transparency and accountability. A brief discussion of the new framework appears below, followed by NASA's FY 2011 and FY 2012 APPs. Due to the change in NASA's performance structure, performance trends for past years mapped to the new performance framework are presented in the following FY 2011 and FY 2012 APPs.

The new performance framework consists of five levels of performance measures. The strategic goals form the top of the framework with four distinct levels supporting the achievement of the overarching goals. Those supporting levels are outcomes, objectives, performance goals, and annual performance goals. Each performance measure level is associated with a specific timeframe.

The strategic goals and outcomes form the top tier of NASA's new performance framework and reflect NASA's long-term plans for the next 10 to 20 years and beyond. These strategic goals may be supported by multiple NASA directorates and offices (see figure 1). In NASA's previous performance framework, Agency-wide activities (formerly represented in Cross-Agency Support) were not previously linked to a specific strategic goal. In NASA's new framework, these activities are now fully incorporated into the goal structure. Strategic goals and outcomes represent the overall direction of the Agency and are the result of intense internal planning and external consultation with the Agency's stakeholders. Reaching out to external stakeholders for their input ensures that NASA has the Nation's goals in mind as the Agency sets its course.

While the strategic goals and outcomes are focused on long-term activities, the objectives, performance goals, and APGs set quantifiable targets for programs, projects, and offices within NASA. Objectives identify targets that span the next 10 years and form the measureable framework for NASA's APPs. These objectives, in turn, are supported by performance goals which focus on planned progress over the next three to five years, with specific annual performance goals (APGs) aligned to the annual budget request.

NASA's former performance framework, consisted of three levels of performance measures: strategic goals (and sub-goals), outcomes, and annual performance goals (APGs). The addition of objectives and performance goals to the new performance framework provides increased transparency into NASA's mid- and near-term plans and performance. (Please see figure 2 for a comparison of NASA's former performance framework to the new performance framework.)

NASA reports progress on each APP to Congress and the public in the Agency's annual Performance and Accountability Report, which supports programmatic decision-making at a government-wide level as well as providing feedback to NASA regarding progress towards its Strategic Goals. NASA's performance framework is also an important tool for communicating with stakeholders and the public. Through this framework, NASA is held accountable for the Nation's investment in NASA's programs and missions, reporting on achievements as well as shortfalls, and informing planning performance for the next year.

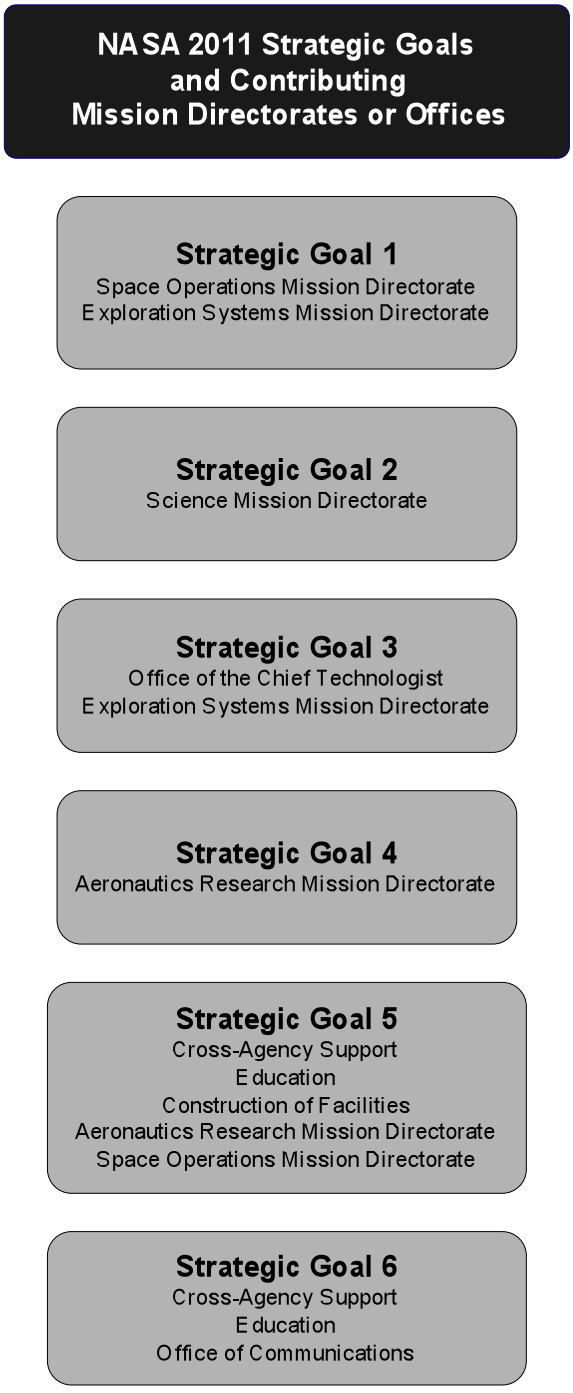

Figure 1: NASA's strategic goals and the Mission Directorates and Mission Support Offices that contribute to each goal.

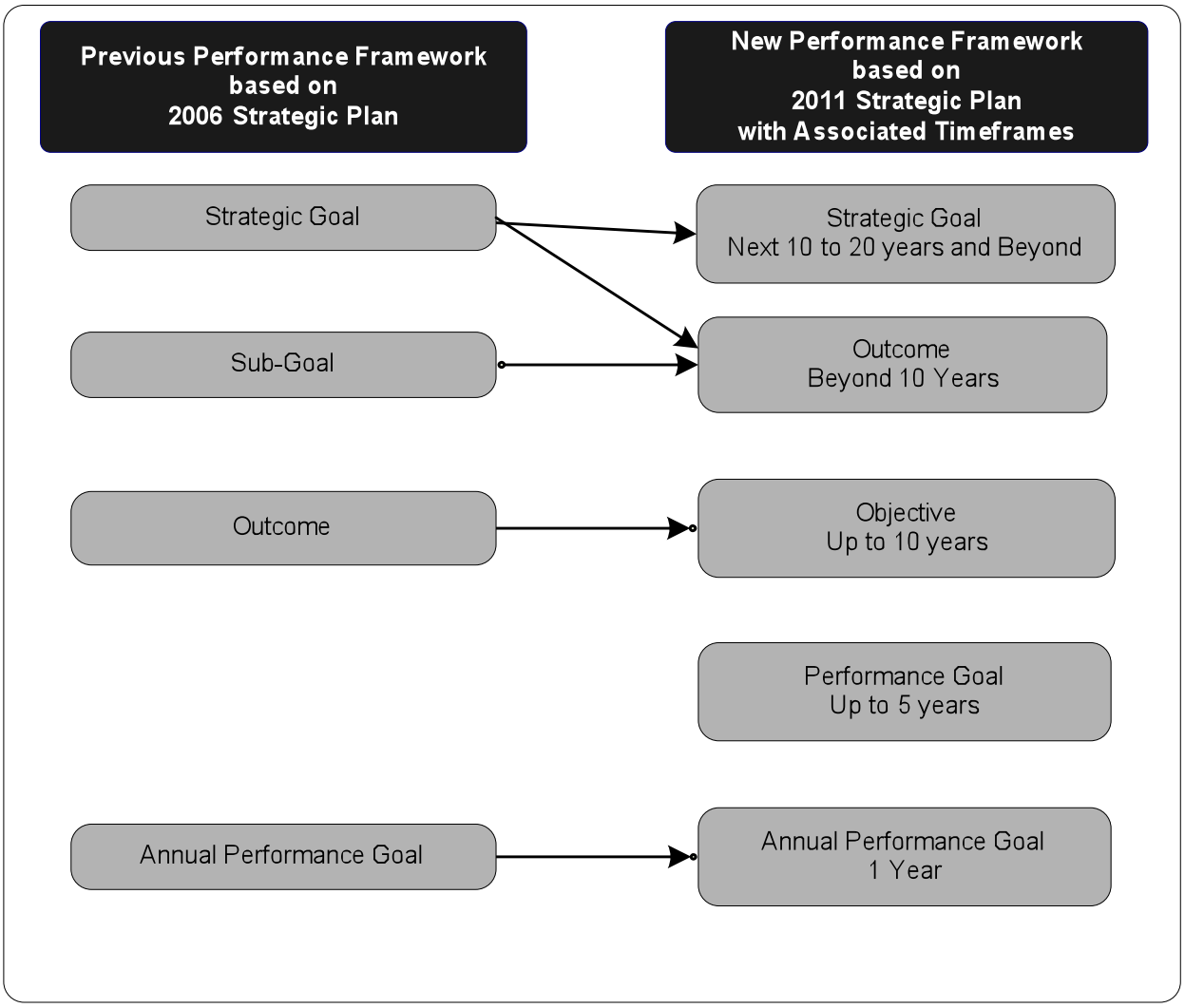

Figure 2: NASA's new performance framework compared to NASA's previous performance framework.

FY 2011 Performance Plan Narrative

The enclosed FY 2011 Performance Plan reflects the current prioritization of Agency programs and projects. In NASA's FY 2011 Budget Estimates, NASA did not include the FY 2011 Performance Plan due to programmatic shifts in direction from the President. NASA chose to align the FY 2011 Performance Plan with the Agency's new 2011 Strategic Plan, hence, the FY 2011 Performance Plan is being presented here for the first time.

The following table provides a summary of all of the Agency commitments identified in the preceding sections of this document.

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 1	**Extend and sustain human activities across the solar system.**		
Outcome 1.1	**Sustain the operation and full use of the International Space Station (ISS) and expand efforts to utilize the ISS as a National Laboratory for scientific, technological, diplomatic, and educational purposes and for supporting future objectives in human space exploration.**		
Objective 1.1.1	**Maintain resources (on orbit and on the ground) to operate and utilize the ISS.**		
Performance Goal 1.1.1.1	***Maintain capability for six on-orbit crew members.***		
APG 1.1.1.1: ISS-11-1	In concert with the International Partners, maintain a continuous crew presence on the ISS by coordinating and managing resources, logistics, systems, and operational procedures.	International Space Station Program	International Space Station
Performance Goal 1.1.1.2	***HPPG: Safely fly out the Space Shuttle manifest and retire the fleet.***		
APG 1.1.1.2: SSP-11-1	Release major Space Shuttle operations facilities at Kennedy Space Center for future institutional and programmatic use.	Space Shuttle Program	Space Shuttle
Performance Goal 1.1.1.3	***Provide cargo and crew transportation to support on-orbit crew members and utilization.***		
APG 1.1.1.3: ISS-11-2	Fly the ISS elements, spares, logistics, and utilization hardware as agreed to by the International Partners in the ISS transportation plan.	International Space Station Program	International Space Station
Performance Goal 1.1.1.4	***Maintain and operate a safe and functional ISS.***		
APG 1.1.1.4: ISS-11-3	Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.	International Space Station Program	International Space Station
APG 1.1.1.4: ISS-11-4	Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps.	International Space Station Program	International Space Station

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 1.1.2	**Advance engineering, technology, and research capabilities on the ISS.**		
Performance Goal 1.1.2.1	***Advance knowledge of long-duration human space flight by establishing agreements with organizations to enable full utilization of the ISS.***		
APG 1.1.2.1: ISS-11-5	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment, as sponsored by NASA, baselined for FY 2011.	International Space Station Program	International Space Station
Performance Goal 1.1.2.2	***Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.***		
APG 1.1.2.2: ERD-11-1	Develop at least two life sciences flight payloads for ISS or Free Flyer platforms.	Advanced Explorations Systems	Exploration Research and Development
APG 1.1.2.2: ERD-11-2	Deliver at least five physical sciences payloads for launch to the ISS.	Advanced Explorations Systems	Exploration Research and Development
APG 1.1.2.2: ERD-11-3	Conduct at least five experiments in combustion, fluids, or materials sciences on the ISS.	Advanced Explorations Systems	Exploration Research and Development
Outcome 1.2	**Develop competitive opportunities for the commercial community to provide best value products and services to low Earth orbit and beyond.**		
Objective 1.2.1	**Enable the commercial sector to provide cargo and crew services to the International Space Station (ISS).**		
Performance Goal 1.2.1.1	***Develop competitive opportunities for the commercial community to provide best value products and services to low Earth orbit and beyond.***		
APG 1.2.1.1: CS-11-1	Conduct a minimum of one commercial cargo demonstration flight of new cargo transportation systems.	Commercial Cargo	Commercial Spaceflight
APG 1.2.1.1: CS-11-2	Conduct a minimum of one commercial cargo demonstration flight of proximity operations with ISS.	Commercial Cargo	Commercial Spaceflight
APG 1.2.1.1: CS-11-3	Conduct a minimum of one safe berthing of commercial cargo transportation systems with the ISS.	Commercial Cargo	Commercial Spaceflight
APG 1.2.1.1: CS-11-4	Release announcement for the development of commercial crew transportation systems (CCDev2).	Commercial Crew	Commercial Spaceflight
Performance Goal 1.2.1.2	***Develop and document evaluation and certification processes for an integrated commercial crew transportation system.***		
APG 1.2.1.2: CS-11-5	Develop NASA processes and requirements required to ensure crew safety to and from the ISS and other NASA and low Earth orbit destinations.	Commercial Crew	Commercial Spaceflight

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 1.3	**Develop an integrated architecture and capabilities for safe crewed and cargo missions beyond low Earth orbit.**		
Objective 1.3.1	**Execute development of an integrated architecture to conduct human space exploration missions beyond low Earth orbit.**		
Performance Goal 1.3.1.1	***Complete design reviews for Space Launch System (SLS).***		
APG 1.3.1.1: HEC-11-1	Develop top-level Agency requirements and draft Program Plan for Space Launch System (SLS).	Space Launch System	Human Exploration Capabilities
Performance Goal 1.3.1.2	***Complete design reviews for Multi-Purpose Crew Vehicle (MPCV).***		
APG 1.3.1.2: HEC-11-2	Develop top-level Agency requirements and Program Plan for Multi-Purpose Crew Vehicle (MPCV).	Multi-Purpose Crew Vehicle	Human Exploration Capabilities
Objective 1.3.2	**Develop a robust biomedical research portfolio to mitigate space human health risks.**		
Performance Goal 1.3.2.1	***Develop technologies that enable biomedical research and mitigate space human health risks associated with human space exploration missions.***		
APG 1.3.2.1: ERD-11-4	Develop and release two NASA Research Announcements that solicit from the external biomedical research community the highest quality proposals to mitigate space human health risks.	Human Research	Exploration Research and Development
Performance Goal 1.3.2.2	***Perform research to ensure that future human crews are protected from the deleterious effects of space radiation.***		
APG 1.3.2.2: ERD-11-5	Complete the independent assessment of the updated NASA Space Radiation Cancer Risk Model used to project the cancer risk for current ISS crews and future exploration missions.	Human Research	Exploration Research and Development
Performance Goal 1.3.2.3	***Develop exploration medical capabilities for long-duration space missions.***		
APG 1.3.2.3: ERD-11-6	Develop and begin implementation of a research plan to address a recently discovered risk to crewmembers involving microgravity-induced visual alterations.	Human Research	Exploration Research and Development

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 2	**Expand scientific understanding of the Earth and the universe in which we live.**		
Outcome 2.1	**Advance Earth system science to meet the challenges of climate and environmental change.**		
Objective 2.1.1	**Improve understanding of and improve the predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.**		
Performance Goal 2.1.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.1.1: ES-11-1	Demonstrate planned progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.1.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.1.2: ES-11-2	Complete the Aquarius Launch Readiness Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.1.2: ES-11-3	Initiate the Orbiting Carbon Observatory-2 (OCO-2) Instrument and Spacecraft System-Level Testing.	Earth System Science Pathfinder	Earth Science
APG 2.1.1.2: ES-11-4	Release Earth Venture 2 (EV-2) Announcement of Opportunity.	Earth System Science Pathfinder	Earth Science
Objective 2.1.2	**Enable improved predictive capability for weather and extreme weather events.**		
Performance Goal 2.1.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.2.1: ES-11-5	Demonstrate planned progress in enabling improved predictive capability for weather and extreme weather events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.2.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.2.2: ES-11-6	Complete the Global Precipitation Mission (GPM) Systems Integration Review.	Earth Systematic Missions	Earth Science

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.1.3	**Quantify, understand, and predict changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.**		
Performance Goal 2.1.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.3.1: ES-11-7	Demonstrate planned progress in quantifying, understanding, and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.3.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.3.2: ES-11-8	Complete the Landsat Data Continuity Mission (LDCM) Mission Operations Review.	Earth Systematic Missions	Earth Science
APG 2.1.3.2: ES-11-3	Initiate the Orbiting Carbon Observatory-2 (OCO-2) Instrument and Spacecraft System-Level Testing.	Earth System Science Pathfinder	Earth Science
Objective 2.1.4	**Quantify the key reservoirs and fluxes in the global water cycle and assess water cycle change and water quality.**		
Performance Goal 2.1.4.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.4.1: ES-11-9	Demonstrate planned progress in quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.4.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.4.2: ES-11-10	Complete the Soil Moisture Active-Passive (SMAP) Confirmation Review.	Earth Systematic Missions	Earth Science
APG 2.1.4.2: ES-11-3	Complete the Aquarius Launch Readiness Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.4.2: ES-11-6	Complete the Global Precipitation Mission (GPM) Systems Integration Review.	Earth Systematic Missions	Earth Science
Objective 2.1.5	**Improve understanding of the roles of the ocean, atmosphere, land and ice in the climate system and improve predictive capability for its future evolution.**		
Performance Goal 2.1.5.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.5.1: ES-11-11	Demonstrate planned progress in understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 2.1.5.2	***HPPG: Study Earth from space to understand climate change, weather, and human impact on our planet by launching at least two missions by 2015.***		
APG 2.1.5.2: ES-11-12	Complete the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) Mission Readiness Review.	Earth Systematic Missions	Earth Science
APG 2.1.5.2: ES-11-13	Complete the Glory Launch Readiness Review.	Earth Systematic Missions	Earth Science
Performance Goal 2.1.5.3	***By 2015, launch at least three missions in support of this objective.***		
APG 2.1.5.3: ES-11-14	Complete the ICESat-2 Spacecraft System Requirements Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.5.3: ES-11-3	Initiate the Orbiting Carbon Observatory-2 (OCO-2) Instrument and Spacecraft System-Level Testing.	Earth System Science Pathfinder	Earth Science
Objective 2.1.6	**Characterize the dynamics of Earth's surface and interior and form the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.**		
Performance Goal 2.1.6.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.6.1: ES-11-15	Demonstrate planned progress in characterizing the dynamics of Earth's surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.6.2	***By 2015, launch at least one mission in support of this objective.***		
APG 2.1.6.2: ES-11-8	Complete the Landsat Data Continuity Mission (LDCM) Mission Operations Review.	Earth Systematic Missions	Earth Science
Objective 2.1.7	**Enable the broad use of Earth system science observations and results in decision-making activities for societal benefits.**		
Performance Goal 2.1.7.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.7.1: ES-11-16	Conduct impact analyses of two projects that apply NASA Earth science research to support decision-making activities.	Applied Sciences	Earth Science
APG 2.1.7.1: ES-11-17	Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.	Earth Science Research	Earth Science
APG 2.1.7.1: ES-11-18	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.	Earth Science Research	Earth Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 2.2	**Understand the Sun and its interactions with Earth and the solar system.**		
Objective 2.2.1	**Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.**		
Performance Goal 2.2.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.1.1: HE-11-1	Demonstrate planned progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics
Performance Goal 2.2.1.2	***By 2015, launch two missions in support of this outcome.***		
APG 2.2.1.2: HE-11-2	Complete the Magnetospheric MultiScale (MMS) Mission Operations Center and Science Operations Center Preliminary Design Review.	Solar Terrestrial Probes	Heliophysics
APG 2.2.1.2: HE-11-3	Complete the Geospace Radiation Belt Storm Probes Systems Integration Review.	Living with a Star	Heliophysics
Objective 2.2.2	**Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.**		
Performance Goal 2.2.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.2.1: HE-11-4	Demonstrate planned progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics
Performance Goal 2.2.2.2	***By 2015, launch two missions in support of this outcome.***		
APG 2.2.2.2: HE-11-2	Complete the Magnetospheric MultiScale (MMS) Mission Operations Center/Science Operations Center Preliminary Design Review.	Solar Terrestrial Probes	Heliophysics
APG 2.2.2.2: HE-11-3	Complete the Geospace Radiation Belt Storm Probes Systems Integration Review.	Living with a Star	Heliophysics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.2.3	**Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.**		
Performance Goal 2.2.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.3.1: HE-11-5	Demonstrate planned progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics
Performance Goal 2.2.3.2	***By 2017, launch at least two missions in support of this outcome.***		
APG 2.2.3.2: HE-11-3	Complete the Geospace Radiation Belt Storm Probes Systems Integration Review.	Living with a Star	Heliophysics
Outcome 2.3	**Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.**		
Objective 2.3.1	**Inventory solar system objects and identify the processes active in and among them.**		
Performance Goal 2.3.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.1.1: PS-11-1	Demonstrate planned progress in inventorying solar system objects and identifying the processes active in and among them. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
APG 2.3.1.1: PS-11-2	Achieve arrival of Dawn at Vesta.	Discovery	Planetary Science
Performance Goal 2.3.1.2	***By 2015, launch at least two missions in support of this outcome.***		
APG 2.3.1.2: PS-11-3	Complete the mission concept studies for the New Frontiers 3 mission.	New Frontiers	Planetary Science
Objective 2.3.2	**Improve understanding of how the Sun's family of planets, satellites, and minor bodies originated and evolved.**		
Performance Goal 2.3.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.2.1: PS-11-4	Demonstrate planned progress in understanding how the Sun's family of planets, satellites, and minor bodies originated and evolved. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
APG 2.3.2.1: PS-11-5	Complete the MESSENGER Mercury Orbit Insertion.	Discovery	Planetary Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 2.3.2.2	***By 2015, launch at least three missions in support of this outcome.***		
APG 2.3.2.2: PS-11-3	Complete the mission concept studies for the New Frontiers 3 mission.	New Frontiers	Planetary Science
APG 2.3.2.2: PS-11-6	Complete the Juno Launch Readiness Review.	New Frontiers	Planetary Science
APG 2.3.2.2: PS-11-7	Complete the Gravity Recovery and Interior Laboratory (GRAIL) Pre-Ship Review.	Discovery	Planetary Science
Objective 2.3.3	**Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.**		
Performance Goal 2.3.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.3.1: PS-11-8	Demonstrate planned progress in understanding the processes that determine the history and future of habitability of environments on Mars and other solar system bodies. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Performance Goal 2.3.3.2	***By 2015, launch at least two missions in support of this outcome.***		
APG 2.3.3.2: PS-11-10	Complete the Mars Atmosphere and Volatile EvolutioN Mission (MAVEN) Confirmation Review.	Mars Exploration	Planetary Science
APG 2.3.3.2: PS-11-9	Complete the Mars Science Laboratory (MSL) Pre-Ship Review.	Mars Exploration	Planetary Science
Objective 2.3.4	**Improve understanding of the origin and evolution of Earth's life and biosphere to determine if there is or ever has been life elsewhere in the universe.**		
Performance Goal 2.3.4.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.4.1: PS-11-11	Demonstrate planned progress in understanding the origin and evolution of life on Earth and throughout the biosphere to determine if there is or ever has been life elsewhere in the universe. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.3.5	**Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.**		
Performance Goal 2.3.5.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.5.1: PS-11-12	Demonstrate planned progress in identifying and characterizing small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Performance Goal 2.3.5.2	***Return data for selection of destinations in order to lower risk for human space exploration beyond low Earth orbit.***		
APG 2.3.5.2: PS-11-13	Develop an archive of high resolution images of the moon from the Lunar Reconnaissance Orbiter (LRO) necessary for human space exploration to determine potential landing sites.	Multiple Programs	Planetary Science
Outcome 2.4	**Discover how the universe works, explore how it began and evolved, and search for Earth-like planets.**		
Objective 2.4.1	**Improve understanding of the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity.**		
Performance Goal 2.4.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.1.1: AS-11-1	Demonstrate planned progress in understanding the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics
Performance Goal 2.4.1.2	***By 2015, launch at least one mission in support of this outcome.***		
APG 2.4.1.2: AS-11-2	Complete the Nuclear Spectroscopic Telescope Array (NuSTAR) Systems Integration Review.	Astrophysics Explorer	Astrophysics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.4.2	**Improve understanding of the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today.**		
Performance Goal 2.4.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.2.1: AS-11-3	Demonstrate planned progress in understanding the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics
Performance Goal 2.4.2.2	***Design and assemble James Webb Space Telescope (JWST).***		
APG 2.4.2.2: JWST-11-1	Complete new James Webb Space Telescope (JWST) mission re-baseline.	James Webb Space Telescope	James Webb Space Telescope
Performance Goal 2.4.2.3	***Develop and operate an airborne infrared astrophysics observatory.***		
APG 2.4.2.3: AS-11-4	Initiate the Stratospheric Observatory for Infrared Astronomy (SOFIA) science observations.	Cosmic Origins	Astrophysics
Objective 2.4.3	**Generate a census of extra-solar planets and measure their properties.**		
Performance Goal 2.4.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.3.1: AS-11-5	Demonstrate planned progress in generating a census of extra-solar planets and measuring their properties. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 3	**Create the innovative new space technologies for our exploration, science, and economic future.**		
Outcome 3.1	**Sponsor early-stage innovation in space technologies in order to improve the future capabilities of NASA, other government agencies, and the aerospace industry.**		
Objective 3.1.1	**Create a pipeline of new low Technology Readiness Levels (TRL) innovative concepts and technologies for future NASA missions and national needs.**		
Performance Goal 3.1.1.1	***Explore revolutionary aerospace concepts, with an initial research phase for preliminary assessment of a broad range of ideas, and a second phase for further development of the most promising concepts.***		
APG 3.1.1.1: ST-11-1	Initiate 10 Phase I research efforts to explore revolutionary aerospace ideas.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.2	***Provide cash prize incentives to non-traditional sources for innovations of interest and value to NASA and the Nation.***		
APG 3.1.1.2: ST-11-2	Conduct at least two Centennial Challenge competitions.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.3	***Establish and maintain a culture of innovation at each of the 10 NASA Centers through the development of new Center ideas and technologies.***		
APG 3.1.1.3: ST-11-3	Twenty innovative projects will be initiated across the NASA Centers.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.4	***Increase the proportion of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies successfully infused into NASA programs/projects.***		
APG 3.1.1.4: ST-11-4	At least 24 percent of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase II technology projects awarded between 2006-2010 will be infused into NASA programs and projects.	SBIR and STTR	Space Technology
Performance Goal 3.1.1.5	***Increase the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase III contracts initiated or expanded.***		
APG 3.1.1.5: ST-11-5	At least 40 of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies will be advanced to Phase III (received non-SBIR/STTR funding).	SBIR and STTR	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 3.1.1.6	***Accelerate the development of push technologies to support the future space, science and exploration needs of NASA, other government agencies, and the commercial space sector.***		
APG 3.1.1.6: ST-11-6	Select 100 NASA space technology research activities.	Crosscutting Space Technology Development	Space Technology
Outcome 3.2	**Infuse game changing and crosscutting technologies throughout the Nation's space enterprise to transform the Nation's space mission capabilities.**		
Objective 3.2.1	**Prove the technical feasibility of potentially disruptive new space technologies for future missions.**		
Performance Goal 3.2.1.1	***Transition developed game changing technologies to the technology demonstration programs or directly to Mission Directorates for mission insertion.***		
APG 3.2.1.1: ST-11-7	Initiate 10 conceptual studies to define potential game changing development projects.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.2	**Spur the development of routine, low-cost access to space through small payloads and satellites.**		
Performance Goal 3.2.2.1	***Mature technologies that enable small satellites to provide game changing capabilities for the government and commercial space sectors.***		
APG 3.2.2.1: ST-11-8	Initiate development of at least one new technology with game changing potential for small satellites.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.3	**Demonstrate new space technologies and infuse them into future science and exploration small satellite missions and/or commercial use.**		
Performance Goal 3.2.3.1	***Demonstrate small satellite capabilities with game changing and crosscutting potential for the government and commercial space sectors.***		
APG 3.2.3.1: ST-11-9	Initiate at least one new small satellite mission that will demonstrate game changing or crosscutting technologies in space.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.4	**Demonstrate new space technologies and infuse them into missions.**		
Performance Goal 3.2.4.1	***Infuse game changing and crosscutting technologies into future NASA missions through flight or relevant environment demonstrations.***		
APG 3.2.4.1: ST-11-10	Select two candidate system level technologies that will provide new capabilities for future missions.	Crosscutting Space Technology Development	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 3.2.5	**Provide flight opportunities and relevant environments to demonstrate new space technologies.**		
Performance Goal 3.2.5.1	***Perform sub-orbital, simulated zero-gravity and other space analog flight opportunities to develop and demonstrate emerging ideas and technologies.***		
APG 3.2.5.1: ST-11-11	Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least three commercial reusable suborbital and parabolic platform providers.	Crosscutting Space Technology Development	Space Technology
Outcome 3.3	**Develop and demonstrate the critical technologies that will make NASA's exploration, science, and discovery missions more affordable and more capable.**		
Objective 3.3.1	**Demonstrate in-space operations of robotic assistants working with crew.**		
Performance Goal 3.3.1.1	***Demonstrate robotic technologies that support in-space operations, scientific discovery, and work as assistants with the crew.***		
APG 3.3.1.1: ERD-11-7	Launch Robonaut 2 to the ISS and demonstrate teleoperation from the ground.	Exploration Technology Development	Space Technology
Objective 3.3.2	**Develop and demonstrate critical technologies for safe and affordable cargo and human space exploration missions beyond low Earth orbit.**		
Performance Goal 3.3.2.1	***Develop advanced spacesuits to improve the ability of astronauts to conduct Extra-Vehicular Activity (EVA) operations in space including assembly and service of in-space systems and exploration of surfaces of the Moon, Mars, near-Earth objects (NEOs), and other small bodies.***		
APG 3.3.2.1: ERD-11-8	Test breadboard Extra-Vehicular Activity (EVA) Portable Life Support System (PLSS) technologies to enable advanced spacesuits for human deep space exploration.	Advanced Explorations Systems	Exploration Research and Development
Performance Goal 3.3.2.2	***Develop technologies and mission concepts for demonstrating in-space cryogenic propellant storage and transfer making exploration and science missions more affordable and capable.***		
APG 3.3.2.1: ST-11-12	Develop and test Liquid Acquisition Devices (LADs) and mass-gauging to support future Cryogenic Propellant Storage And Transfer (CRYOSTAT) missions.	Exploration Technology Development	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 3.4	**Facilitate the transfer of NASA technology and engage in partnerships with other government agencies, industry, and international entities to generate U.S. commercial activity and other public benefits.**		
Objective 3.4.1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and national interests.**		
Performance Goal 3.4.1.1	***Establish 12 technology-related significant partnerships that create value for programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety) per year.***		
APG 3.4.1.1: ST-11-13	Establish at least 12 technology-related significant partnerships during FY 2011.	Partnership Development and Strategic Integration	Space Technology
Performance Goal 3.4.1.2	***Complete 30 technology transfer agreements with the commercial and academic community through such mechanisms as licenses, software use agreements, facility use agreements, and Space Act Agreements per year.***		
APG 3.4.1.2: ST-11-14	Complete at least 30 technology transfer agreements during FY 2011.	Partnership Development and Strategic Integration	Space Technology
Performance Goal 3.4.1.3	***Successful application of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies into commercial products or services.***		
APG 3.4.1.3: ST-11-15	Greater than 35 percent of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase II technology projects awarded between 2006-2010 will be transferred into commercial products or services.	SBIR and STTR	Space Technology
Performance Goal 3.4.1.4	***Document 40-50 of the most notable examples of successful transfer and commercialization of NASA-derived technology per year and publish in Spinoff annually.***		
APG 3.4.1.4: ST-11-16	Document at least 40 notable technology transfer successes in NASA's Spinoff publication.	Partnership Development and Strategic Integration	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 3.4.1.5	***Document, coordinate, and prioritize Agency-level technology strategic investments to ensure NASA has a balanced portfolio of both near-term NASA mission (pull) technologies and longer-term transformational (push) technologies that benefit both Agency programs and national needs.***		
APG 3.4.1.5: ST-11-17	Develop an Agency technology portfolio database to track technology investments and create space technology roadmaps that prioritize these investments.	Partnership Development and Strategic Integration	Space Technology
Strategic Goal 4	**Advance aeronautics research for societal benefit.**		
Outcome 4.1	**Develop innovative solutions and advanced technologies through a balanced research portfolio to improve current and future air transportation.**		
Objective 4.1.1	**Develop advanced technologies to improve the overall safety of the future air transportation system.**		
Performance Goal 4.1.1.1	***Transfer knowledge to the aviation community to better manage safety in aviation.***		
APG 4.1.1.1: AR-11-1	Demonstrate scalable anomaly detection on heterogeneous data.	Aviation Safety	Aeronautics
APG 4.1.1.1: AR-11-2	Demonstrate self-healing material concepts to mitigate damage in structural elements.	Aviation Safety	Aeronautics
Objective 4.1.2	**Develop innovative solutions and technologies to meet future capacity and mobility requirements of the Next Generation Air Transportation System (NextGen).**		
Performance Goal 4.1.2.1	***HPPG: Increase efficiency and throughput of aircraft operations during arrival phase of flight.***		
APG 4.1.2.1: AR-11-3	Conduct simulations of initial tactical conflict prediction and resolution advisory functions to address reduction in false alerts and increase in time to detect a loss of separation in terminal operations.	Airspace Systems	Aeronautics
APG 4.1.2.1: AR-11-4	Specify operational requirements for performing Multi-Sector Planning (MSP) functions in the mid-term, including technical and conceptual requirements, with consideration of how requirements might change as the National Airspace System (NAS) evolves towards NextGen.	Airspace Systems	Aeronautics
APG 4.1.2.1: AR-11-5	Report on human-in-the-loop (HITL) simulation and model results. (HPPG milestone)	Airspace Systems	Aeronautics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 4.1.3	**Develop tools, technologies, and knowledge that enable significantly improved performance and new capabilities for future air vehicles.**		
Performance Goal 4.1.3.1	***Deliver tools, technologies, and knowledge that can be used to more efficiently and effectively design future air vehicles and their components that overcome national performance and capability challenges.***		
APG 4.1.3.1: AR-11-6	Achieve validated accuracy for conventional and unconventional aircraft, respectively, for nitrogen dioxide (NOx), takeoff and landing performance, cruise performance, take-off gross weight (TOGW), and noise.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-11-7	Demonstrate the ability to predict the effect of impact dynamics on a full-scale airframe within 10 percent of measured acceleration.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-11-8	Demonstrate the ability to optimize a baseline aircraft design to simultaneously achieve high cruise efficiency and low sonic boom using Multidisciplinary Design, Analysis and Optimization (MDAO) with a two-week cycle time.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-11-9	Validate NASA propulsion Computational Fluid Dynamics (CFD) codes using Hypersonic International Flight Research Experimentation (HIFiRE) scramjet flight data and ground-based test results.	Fundamental Aeronautics	Aeronautics
Outcome 4.2	**Conduct systems-level research on innovative and promising aeronautics concepts and technologies to demonstrate integrated capabilities and benefits in a relevant flight and/or ground environment.**		
Objective 4.2.1	**Develop advanced tools and technologies that reduce the technical risk associated with system-level integration of promising aeronautical concepts.**		
Performance Goal 4.2.1.1	***Reduce technical risk by conducting research at an integrated system-level on promising aeronautical concepts and technologies in a relevant environment.***		
APG 4.2.1.1: AR-11-10	Optimize fuel injector designs through flametube and/or sector tests and demonstrate their performance in meeting futuristic aircraft emission goals.	Integrated Systems Research	Aeronautics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 5	**Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.**		
Outcome 5.1	**Identify, cultivate, and sustain a diverse workforce and inclusive work environment that is needed to conduct NASA missions.**		
Objective 5.1.1	**Establish and maintain a workforce that possesses state-of-the-art technical and business management competencies.**		
Performance Goal 5.1.1.1	***Define and build the federal workforce skills and competencies needed for the Agency's future directions in technology development and deep space exploration.***		
APG 5.1.1.1: AMO-11-1	Seventy-five percent or more of Shuttle workforce has been realigned for new Agency needs.	Agency Management	Agency Management and Operations
APG 5.1.1.1: AMO-11-2	Twenty percent or more of annual recruitments will be through the early career hiring initiatives.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.2	***Build skills across all levels of the workforce through Leadership Development Opportunities.***		
APG 5.1.1.2: AMO-11-3	Evaluate current state of Agency leadership training and development and publish findings and recommendations in a comprehensive report to guide future program direction.	Agency Management	Agency Management and Operations
APG 5.1.1.2: AMO-11-4	Seventy-five percent of the Agency's leadership training and development programs include "leading through transformation" content.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.3	***Achieve and sustain an effective labor-management dialogue.***		
APG 5.1.1.3: AMO-11-5	Identify and address at least three significant labor-management challenges identified during the year during periodic Agency-led Labor Management Forums.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.4	***Adopt and respond to innovative employee feedback mechanisms.***		
APG 5.1.1.4: AMO-11-6	Identify and address at least two topics that employees identified in the latest Federal Employee Viewpoint Survey.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.5	***Establish and maintain a workplace environment free of illegal discrimination, harassing conduct, and retaliation for Equal Employment Opportunity (EEO) activity and that provides reasonable accommodations to individuals with disabilities.***		
APG 5.1.1.5: AMO-11-7	Complete FY 2011 actions described in the NASA Model Equal Employment Opportunity (EEO) Agency Plan.	Agency Management	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 5.1.1.6	***Implement an Agency-wide Diversity and Inclusion Framework to develop a more demographically diverse workforce and a more inclusive work environment.***		
APG 5.1.1.6: AMO-11-8	Establish a baseline for diversity by developing and implementing an Agency-wide diversity-inclusion survey.	Agency Management	Agency Management and Operations
Objective 5.1.2	**Provide opportunities and support systems that recruit, retain, and develop undergraduate and graduate students in STEM-related disciplines.**		
Performance Goal 5.1.2.1	***Assure that student participants in NASA higher education projects are representative of the diversity of the Nation.***		
APG 5.1.2.1: ED-11-1	Achieve 40 percent participation of underserved and underrepresented (in race and/or ethnicity) in NASA higher education projects.	STEM Education and Accountability	Education
APG 5.1.2.1: ED-11-2	Achieve 45 percent participation of women in NASA higher education projects.	STEM Education and Accountability	Education
Outcome 5.2	**Ensure vital assets are ready, available, and appropriately sized to conduct NASA's missions.**		
Objective 5.2.1	**Achieve mission success by factoring safety, quality, risk, reliability, and maintainability as integral features of programs, projects, technologies, operations, and facilities.**		
Performance Goal 5.2.1.1	***Through 2015, assure zero fatalities or permanent disabling injuries to the public.***		
APG 5.2.1.1: AMO-11-9	Assure zero fatalities or permanent disabling injuries to the public resulting from NASA activities during the fiscal year.	Safety and Mission Success	Agency Management and Operations
Performance Goal 5.2.1.2	***By 2015, achieve a four percent reduction in the total case rate and lost time rate for the NASA civil service work force.***		
APG 5.2.1.2: AMO-11-10	Reduce Total Case Rate and Lost Time Case Rate by one percent, in accordance with the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.	Safety and Mission Success	Agency Management and Operations
Performance Goal 5.2.1.3	***By 2015, reduce damage to NASA assets by eight percent from the 2010 baseline.***		
APG 5.2.1.3: AMO-11-11	Reduce damage to NASA assets by two percent per fiscal year, based on a five-year running average.	Safety and Mission Success	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 5.2.2	**Provide information technology that advances NASA space and research program results and promotes open dissemination through efficient, innovative, reliable, and responsive services that are appropriately secure and valued by stakeholders and the public.**		
Performance Goal 5.2.2.1	***By 2014, consolidate and centralize the management of information technology (IT) enterprise services for end user services, communications, enterprise applications, enterprise data centers, and web services.***		
APG 5.2.2.1: AMO-11-12	Achieve Initial Operating Capability (IOC) for five Service Offices (Web Services, Communications, Enterprise Service Desk, End User Services, and NASA Enterprise Applications) as part of the NASA Information Technology Infrastructure Integration Program (I3P).	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.2	***By 2015, implement a capability to identify and prevent unauthorized intrusions on the NASA institutional and mission networks.***		
APG 5.2.2.2: AMO-11-13	Implement intrusion detection sensors monitored by the NASA Security Operations Center (SOC) on 75 percent of NASA institutional network monitoring sites.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.3	***By 2014, decommission the Agency Administrative mainframe computer.***		
APG 5.2.2.3: AMO-11-14	Implement, in the SAP environment, the replacement for the mainframe-based NASA Supply Management System.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.4	***By 2015, reduce data center energy consumption by 30 percent.***		
APG 5.2.2.4: AMO-11-15	Develop a data center consolidation plan for NASA that includes an enterprise assessment of NASA's data center footprint.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.5	***By 2015, establish at least four innovation laboratories that provide more effective, efficient, and responsive information technology (IT) across NASA in support of the Agency's Mission.***		
APG 5.2.2.5: AMO-11-16	Implement a Core Information Technology (IT) Innovation Laboratory infrastructure to support experimental technology incubation activities in areas ranging from communications, information dissemination, and collaboration application interoperability in a cloud environment.	Agency IT Services (AITS)	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 5.2.3	**Develop and implement long-range infrastructure plans that address institutional capabilities and critical assets, directly link to mission needs, ensure the leveraging of external capabilities, and provide a framework for Agency infrastructure decision-making.**		
Performance Goal 5.2.3.1	***Consolidate functions and offices to reduce real property need, and use Agency Integrated Master Plan to identify and dispose of excess and aged facilities beyond useful life.***		
APG 5.2.3.1 AMO-11-17	Finalize 8 of 10 Center Master Plans and incorporate into the Agency Integrated Master Plan.	Agency Management	Agency Management and Operations
APG 5.2.3.1: COF-11-1	Initiate facilities demolition process for five significant Agency facilities.	Institutional CoF	Construction of Facilities
Performance Goal 5.2.3.2	***HPPG: Conserve valuable natural resources by reducing NASA's energy and water use.***		
APG 5.2.3.2: ECR-11-1	Reduce energy intensity use annually by three percent from an FY 2003 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
APG 5.2.3.2: ECR-11-2	Reduce potable water use annually by two percent from an FY 2007 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
APG 5.2.3.2: ECR-11-3	Reduce fleet vehicle energy use annually by two percent of petroleum products from an FY 2005 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
Outcome 5.3	**Ensure the availability to the Nation of NASA-owned, strategically important test capabilities.**		
Objective 5.3.1	**Work with the National Rocket Propulsion Test Alliance to identify NASA, Department of Defense and commercial capabilities and requirements.**		
Performance Goal 5.3.1.1	***Develop and execute the Rocket Propulsion Test (RPT) Master Plan.***		
APG 5.3.1.1: SFS-11-1	Release the Rocket Propulsion Test (RPT) Master Plan.	Rocket Propulsion Test	Space and Flight Support (SFS)
Objective 5.3.2	**Ensure that Aeronautics Test Program (ATP) facilities are available and capable of supporting research, development, test and engineering goals and objectives for NASA and national aerospace programs.**		
Performance Goal 5.3.2.1	***Ensure that testing capabilities are available in order to support the research, development, test, and engineering milestones of NASA and Department of Defense (DoD) programs.***		
APG 5.3.2.1: AR-11-11	Achieve ratings greater than 86 percent for overall quality and timeliness of Aeronautics Test Program (ATP) facility operations.	Aeronautics Test	Aeronautics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 5.4	**Implement and provide space communications and launch capabilities responsive to existing and future science and space exploration missions.**		
Objective 5.4.1	**Ensure reliable and cost-effective access to space for missions critical to achieving the National Space Policy of the United States of America.**		
Performance Goal 5.4.1.1	***Complete Launch Services Program (LSP) objectives for all NASA-managed expendable launches.***		
APG 5.4.1.1: SFS-11-2	Sustain 100 percent success rate with the successful launch of NASA-managed expendable launches as identified on the Launch Services Flight Planning Board manifest.	Launch Services	Space and Flight Support (SFS)
Performance Goal 5.4.1.2	***Continue utilizing existing contract mechanisms and agreements with emerging launch vehicle providers to gain information for future Launch Service orders and to provide technical exchanges to enhance early launch success.***		
APG 5.4.1.2: SFS-11-3	Develop processes for crew transportation partner information sharing between NASA's Launch Services Program (LSP), Exploration Systems Mission Directorate (ESMD), ISS, and other government customers, including but not limited to Department of Defense (DoD).	Launch Services	Space and Flight Support (SFS)
Objective 5.4.2	**Transform the Florida launch and range complex to provide a robust launch and range infrastructure for future users.**		
Performance Goal 5.4.2.1	***By FY 2014, enable future government and commercial launching and testing from the Florida launch and range complex.***		
APG 5.4.2.1: SFS-11-4	Develop a 21st Century Space Launch Complex (21st CSLC) plan.	21st Century Space Launch Complex	Space and Flight Support (SFS)
Objective 5.4.3	**Build and maintain a scalable, integrated, mission support infrastructure that can readily evolve to accommodate new and changing technologies, while providing integrated, comprehensive, robust, and cost-effective space communications services at order-of-magnitude higher data rates to enable NASA's science and exploration missions.**		
Performance Goal 5.4.3.1	***By 2014, launch two functionally identical Tracking and Data Relay Satellite (TDRS) spacecraft in geosynchronous orbits to replenish the Tracking and Data Relay Satellite System (TDRSS) constellation.***		
APG 5.4.3.1: SFS-11-5	Complete Tracking and Data Relay Satellite (TDRS) K Payload and Bus Integration and test.	Space Communications and Navigation	Space and Flight Support (SFS)

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 5.4.3.2	***By FY 2016, replace or upgrade obsolete and unsustainable systems of the Tracking and Data Relay Satellite System (TDRSS) Ground Segment at the White Sands Complex (WSC).***		
APG 5.4.3.2: SFS-11-6	Complete the Space Network Ground Support Sustainment (SGSS) Integrated Baseline Review (IBR) and Systems Requirements Review (SRR).	Space Communications and Navigation	Space and Flight Support (SFS)
Performance Goal 5.4.3.3	***By FY 2018, replace aging and obsolete Deep Space Network (DSN) 70-meter antenna at Canberra Deep Space Communications Complex (CDSCC).***		
APG 5.4.3.3: SFS-11-7	Complete Deep Space Station-35 (DSS-35) Pedestal Excavation and Azimuth track at Canberra Deep Space Communications Complex (CDSCC).	Space Communications and Navigation	Space and Flight Support (SFS)
Outcome 5.5	**Establish partnerships, including innovative arrangements, with commercial, international, and other government entities to maximize mission success.**		
Objective 5.5.1	**Facilitate the use of the ISS as a National Laboratory for cooperative research, technology development, and education.**		
Performance Goal 5.5.1.1	***HPPG: Establish an independent non-profit (NPO) organization to enhance the utilization of the ISS as a National Laboratory.***		
APG 5.5.1.1: ISS-11-6	Transition management of the ISS U.S. National Laboratory for non-NASA research to the non-profit organization (NPO).	International Space Station Program	International Space Station
Objective 5.5.2	**Enhance international and interagency partnerships through increased use of international and interagency coordination mechanisms.**		
Performance Goal 5.5.2.1	***Actively engage and provide leadership in international and interagency forums.***		
APG 5.5.2.1: AMO-11-18	Complete the International Space Exploration Coordination Group (ISECG) roadmap to identify common interests among international space agencies in human and robotic exploration of the solar system.	Agency Management	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 6	**Share NASA with the public, educators, and students to provide opportunities to participate in our Mission, foster innovation and contribute to a strong national economy.**		
Outcome 6.1	**Improve retention of students in STEM disciplines by providing opportunities and activities along the full length of the education pipeline.**		
Objective 6.1.1	**Provide quality STEM curricular support resources and materials.**		
Performance Goal 6.1.1.1	***Provide educators nationwide with knowledge and tools with which to inspire students in STEM fields.***		
APG 6.1.1.1: ED-11-3	75,000 educators participate in NASA education programs.	STEM Education and Accountability	Education
Objective 6.1.2	**Provide NASA experiences that inspire student interest and achievement in STEM disciplines.**		
Performance Goal 6.1.2.1	***Provide higher education students with authentic NASA mission-based opportunities that build knowledge and skills needed for STEM careers.***		
APG 6.1.2.1: ED-11-4	25,000 undergraduate and graduate students participate in NASA education opportunities.	STEM Education and Accountability	Education
Performance Goal 6.1.2.2	***Provide elementary and secondary students with authentic NASA mission-based opportunities that build STEM knowledge, skills, and career awareness.***		
APG 6.1.2.2: ED-11-5	600,000 elementary and secondary students participate in NASA instructional and enrichment activities.	STEM Education and Accountability	Education
APG 6.1.2.2: ED-11-6	75 percent of elementary and secondary students express interest in STEM careers following their involvement in NASA education programs.	STEM Education and Accountability	Education
Objective 6.1.3	**Assess grant recipient institutions throughout the education pipeline to ensure that grant recipients demonstrate a consistent commitment to civil rights compliance.**		
Performance Goal 6.1.3.1	***Promote equal opportunity compliance and encourage promising practices among NASA grant recipient institutions through a fully-realized program of civil rights compliance reviews, policy guidance, and technical assistance.***		
APG 6.1.3.1: AMO-11-19	Equal opportunity (EO) assessment and technical assistance provided, or onsite compliance assessment performed, on-location at five STEM or STEM-related programs that receive NASA funding.	Agency Management	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 6.2	**Promote STEM literacy through strategic partnerships with formal and informal organizations.**		
Objective 6.2.1	**Develop NASA's leadership role in national STEM improvement efforts, as demonstrated by provision of meaningful educator professional development and student experiences, adoption of education technologies, and contributions to STEM education policies and strategies.**		
Performance Goal 6.2.1.1	***Provide educator professional development experiences and materials that align to needs and opportunities identified by districts, states, Department of Education, professional organizations, and other stakeholders.***		
APG 6.2.1.1: ED-11-7	5,000 educators use NASA resources in their curricula after participating in NASA professional development.	STEM Education and Accountability	Education
Performance Goal 6.2.1.2	***Provide expertise in the development of STEM education policies and strategies.***		
APG 6.2.1.2: ED-11-8	Provide expertise to support the National Academies development of a framework for integrated science and engineering standards.	STEM Education and Accountability	Education
Outcome 6.3	**Engage the public in NASA's missions by providing new pathways for participation.**		
Objective 6.3.1	**Extend the reach of participatory engagement across NASA.**		
Performance Goal 6.3.1.1	***By 2015, establish an Agency-wide portfolio of participatory engagement opportunities.***		
APG 6.3.1.1: AMO-11-20	Identify candidate mechanisms to encourage public engagement in NASA programs and missions.	Agency Management	Agency Management and Operations
Outcome 6.4	**Inform, engage, and inspire the public by sharing NASA's missions, challenges, and results.**		
Objective 6.4.1	**Use strategic partnerships with formal and informal educational organizations to provide NASA content to promote interest in STEM.**		
Performance Goal 6.4.1.1	***Leverage communities of practice to facilitate sharing of NASA successes and challenges with the public.***		
APG 6.4.1.1: ED-11-9	420 museums and science centers across the country actively engage the public in major NASA events.	STEM Education and Accountability	Education

FY 2011 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 6.4.2	**Provide clear, accurate, timely, and consistent information that is readily available and suitable for a diverse audience.**		
Performance Goal 6.4.2.1	***Use current and emerging communications technologies to reach increasingly broad audiences.***		
APG 6.4.2.1: AMO-11-21	Establish an Agency-wide portfolio of communication tools.	Agency Management	Agency Management and Operations
Objective 6.4.3	**Provide the communications infrastructure to enable NASA's commitment to make government more open, transparent, and participatory.**		
Performance Goal 6.4.3.1	***Make available Agency records through the Freedom of Information (FOIA), Privacy Act, and Open Government Initiative in accordance with federal laws and regulations.***		
APG 6.4.3.1: AMO-11-22	Issue Agency-wide Freedom of Information Act (FOIA) tools to support consistent responses to requesters.	Agency Management	Agency Management and Operations

FY 2011 Performance Plan

Uniform and Efficiency Measures

Measure #	Description
International Space Station Theme	
APG EFF 1.1.1.4: ISS-11-3	Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.
APG EFF 1.1.2.1: ISS-11-5	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment, as sponsored by NASA, baselined for FY 2011.
Earth Science Theme	
APG EFF 2.1.7.1: ES-11-17	Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.
APG EFF 2.1.7.1: ES-11-18	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.
APG EFF: ES-11-19	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: ES-11-20	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: ES-11-21	Peer-review and competitively award at least 90 percent, by budget, of research projects.
APG EFF: ES-11-22	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Agency Management and Operations Theme	
APG EFF 5.2.1.2: AMO-11-10	Reduce Total Case Rate and Lost Time Case Rate by one percent, in accordance with the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.
APG EFF 5.2.1.3: AMO-11-11	Reduce damage to NASA assets by two percent per fiscal year, based on a five-year running average.
APG EFF: AMO-11-21	Maintain system execution time during the year-end close process at FY 2010 baseline.
Environmental Compliance and Restoration Theme	
APG EFF 5.2.3.2: ECR-11-1	Reduce energy intensity use annually by three percent from an FY 2003 baseline.
APG EFF 5.2.3.2: ECR-11-2	Reduce potable water use annually by two percent from an FY 2007 baseline.
APG EFF 5.2.3.2: ECR-11-3	Reduce fleet vehicle energy use annually by two percent of petroleum products from an FY 2005 baseline.
Aeronautics Theme	
APG EFF: AR-11-12	Deliver at least 86 percent of on-time availability for operations and research facilities.
Astrophysics Theme	
APG EFF: AS-11-6	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: AS-11-7	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: AS-11-8	Peer-review and competitively award at least 95 percent, by budget, of research projects.

FY 2011 Performance Plan

Uniform and Efficiency Measures

Measure #	Description
APG EFF: AS-11-9	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Heliophysics Theme	
APG EFF: HE-11-6	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: HE-11-7	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: HE-11-8	Peer-review and competitively award at least 90 percent, by budget, of research projects.
APG EFF: HE-11-9	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Planetary Science Theme	
APG EFF: PS-11-14	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: PS-11-15	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: PS-11-16	Peer-review and competitively award at least 95 percent, by budget, of research projects.
APG EFF: PS-11-17	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.

FY 2012 Performance Plan Narrative

NASA's updated strategic goals are reflected below. Each is clearly defined and supported by multi-year Outcomes, Objectives, and Performance Goals. These in turn are supported by annual performance goals (APGs) that enhance NASA's ability to measure and report on the Agency's progress in achieving its strategic goals.

To better communicate the contribution of NASA's mission support elements, those performance measures are now structured as function-based, rather than Theme-based. Performance measures that were previously listed under Cross-Agency Support, including Education, information technology services, construction of facilities, human capital management, safety and mission assurance, launch services, and space communications have now been incorporated into the appropriate strategic goal.

The following table provides a summary of all of the Agency commitments identified in the preceding sections of this document.

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 1	**Extend and sustain human activities across the solar system.**		
Outcome 1.1	**Sustain the operation and full use of the International Space Station (ISS) and expand efforts to utilize the ISS as a National Laboratory for scientific, technological, diplomatic, and educational purposes and for supporting future objectives in human space exploration.**		
Objective 1.1.1	**Maintain resources (on orbit and on the ground) to operate and utilize the ISS.**		
Performance Goal 1.1.1.1	***Maintain capability for six on-orbit crew members.***		
APG 1.1.1.1: ISS-12-1	In concert with the International Partners, maintain a continuous crew presence on the ISS by coordinating and managing resources, logistics, systems, and operational procedures.	International Space Station Program	International Space Station
Performance Goal 1.1.1.2	***HPPG: Safely fly out the Space Shuttle manifest and retire the fleet.***		
APG 1.1.1.2: SSP-12-1	Ensure the Space Shuttle Endeavour is ready for transport to its final display location.	Space Shuttle Program	Space Shuttle
Performance Goal 1.1.1.3	***Provide cargo and crew transportation to support on-orbit crew members and utilization.***		
APG 1.1.1.3: ISS-12-2	Fly the ISS spares, logistics, and utilization hardware as agreed to by the International Partners in the ISS transportation plan.	International Space Station Program	International Space Station
APG 1.1.1.3: ISS-12-3	Complete at least two flights to the ISS by U.S. developed cargo delivery systems.	International Space Station Program	International Space Station
Performance Goal 1.1.1.4	***Maintain and operate a safe and functional ISS.***		
APG 1.1.1.4: ISS-12-4	Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.	International Space Station Program	International Space Station

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
APG 1.1.1.4: ISS-12-5	Achieve zero Type-A (damage to property at least $1 million or death) or Type-B (damage to property at least $250 thousand or permanent disability or hospitalization of three or more persons) mishaps.	International Space Station Program	International Space Station
Objective 1.1.2	**Advance engineering, technology, and research capabilities on the ISS.**		
Performance Goal 1.1.2.1	***Advance knowledge of long-duration human space flight by establishing agreements with organizations to enable full utilization of the ISS.***		
APG 1.1.2.1: ISS-12-6	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment, as sponsored by NASA, baselined for FY 2012.	International Space Station Program	International Space Station
Performance Goal 1.1.2.2	***Conduct basic and applied biological and physical research to advance and sustain U.S. scientific expertise.***		
APG 1.1.2.2: ERD-12-1	Conduct flight definition review for at least five flight experiments in fundamental space biology that were selected through the 2010 International Space Life Sciences Research Announcement.	Advanced Explorations Systems	Exploration Research and Development
APG 1.1.2.2: ERD-12-2	Deliver at least four physical sciences payloads for launch to the ISS.	Advanced Explorations Systems	Exploration Research and Development
APG 1.1.2.2: ERD-12-3	Conduct at least six experiments in combustion, fluids, or materials sciences on the ISS.	Advanced Explorations Systems	Exploration Research and Development
Outcome 1.2	**Develop competitive opportunities for the commercial community to provide best value products and services to low Earth orbit and beyond.**		
Objective 1.2.1	**Enable the commercial sector to provide cargo and crew services to the International Space Station (ISS).**		
Performance Goal 1.2.1.1	***Develop competitive opportunities for the commercial community to provide best value products and services to low Earth orbit and beyond.***		
APG 1.2.1.1: CS-12-1	Conclude the commercial crew transportation systems (CCDev2) agreements and make initial selections for the design, development, and demonstration of commercial crew transportation systems.	Commercial Crew	Commercial Spaceflight
Performance Goal 1.2.1.2	***Develop and document evaluation and certification processes for an integrated commercial crew transportation system.***		
APG 1.2.1.2: CS-12-2	Begin evaluation and certification of integrated commercial crew transportation system.	Commercial Crew	Commercial Spaceflight

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 1.3	**Develop an integrated architecture and capabilities for safe crewed and cargo missions beyond low Earth orbit.**		
Objective 1.3.1	**Execute development of an integrated architecture to conduct human space exploration missions beyond low Earth orbit.**		
Performance Goal 1.3.1.1	***Complete design reviews for Space Launch System (SLS).***		
APG 1.3.1.1: HEC-12-1	Successfully complete Space Launch System's (SLS) Systems Requirements Review (SRR).	Space Launch System	Human Exploration Capabilities
Performance Goal 1.3.1.2	***Complete design reviews for Multi-Purpose Crew Vehicle (MPCV).***		
APG 1.3.1.2: HEC-12-2	Complete testing of Multi-Purpose Crew Vehicle (MPCV) Ground Test Article (GTA).	Multi-Purpose Crew Vehicle	Human Exploration Capabilities
Objective 1.3.2	**Develop a robust biomedical research portfolio to mitigate space human health risks.**		
Performance Goal 1.3.2.1	***Develop technologies that enable biomedical research and mitigate space human health risks associated with human space exploration missions.***		
APG 1.3.2.1: ERD-12-4	Develop and release two NASA Research Announcements that solicit from the external biomedical research community the highest quality proposals to mitigate space human health risks.	Human Research	Exploration Research and Development
Performance Goal 1.3.2.2	***Perform research to ensure that future human crews are protected from the deleterious effects of space radiation.***		
APG 1.3.2.2: ERD-12-5	Release Acute Radiation Risk Model Version 2 to assess effects of solar particle events during exploration missions.	Human Research	Exploration Research and Development
Performance Goal 1.3.2.3	***Develop exploration medical capabilities for long-duration space missions.***		
APG 1.3.2.3: ERD-12-6	Deliver the next-generation space biomedical ultrasound device to enhance the Human Research Facility capability on the ISS through 2020.	Human Research	Exploration Research and Development
Objective 1.3.3	**Identify hazards, opportunities, and potential destinations, to support future safe and successful human space exploration missions.**		
Performance Goal 1.3.3.1	***Prioritize the knowledge of hazards, opportunities, and potential destinations for human space exploration that will be of use to future operations of an integrated architecture for human space exploration.***		
APG 1.3.3.1: ERD-12-7	In collaboration with the Planetary Science Division, develop a plan to return data that will support the selection of destinations and reduce risk for future human space exploration missions.	Advanced Explorations Systems	Exploration Research and Development

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Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 2	**Expand scientific understanding of the Earth and the universe in which we live.**		
Outcome 2.1	**Advance Earth system science to meet the challenges of climate and environmental change.**		
Objective 2.1.1	**Improve understanding of and improve the predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.**		
Performance Goal 2.1.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.1.1: ES-12-1	Demonstrate planned progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.1.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.1.2: ES-12-2	Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.1.2: ES-12-3	Complete the Earth Venture 1 (EV-1) Investigation Readiness Reviews (IRR) and begin initial field campaigns.	Earth System Science Pathfinder	Earth Science
Objective 2.1.2	**Enable improved predictive capability for weather and extreme weather events.**		
Performance Goal 2.1.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.2.1: ES-12-4	Demonstrate planned progress in enabling improved predictive capability for weather and extreme weather events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.2.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.2.2 ES-12-5	Complete the Global Precipitation Mission (GPM) Pre-Environmental Review.	Earth Systematic Missions	Earth Science
APG 2.1.2.2: ES-12-3	Complete the EV-1 Investigation Readiness Reviews (IRR) and begin initial field campaigns.	Earth System Science Pathfinder	Earth Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.1.3	**Quantify, understand, and predict changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.**		
Performance Goal 2.1.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.3.1: ES-12-6	Demonstrate planned progress in quantifying, understanding, and predicting changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.3.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.3.2 ES-12-7	Complete the Landsat Data Continuity Mission (LDCM) Systems Integration Review.	Earth Systematic Missions	Earth Science
APG 2.1.3.2: ES-12-2	Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.3.2: ES-12-3	Complete the Earth Venture 1 (EV-1) Investigation Readiness Reviews (IRR) and begin initial field campaigns.	Earth System Science Pathfinder	Earth Science
Objective 2.1.4	**Quantify the key reservoirs and fluxes in the global water cycle and assess water cycle change and water quality.**		
Performance Goal 2.1.4.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.4.1: ES-12-8	Demonstrate planned progress in quantifying the key reservoirs and fluxes in the global water cycle and assessing water cycle change and water quality. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.4.2	***By 2015, launch at least two missions in support of this objective.***		
APG 2.1.4.2: ES-12-5	Complete the Global Precipitation Mission (GPM) Pre-Environmental Review.	Earth Systematic Missions	Earth Science
APG 2.1.4.2: ES-12-9	Successfully complete the Soil Moisture Active-Passive (SMAP) Critical Design Review.	Earth Systematic Missions	Earth Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.1.5	**Improve understanding of the roles of the ocean, atmosphere, land and ice in the climate system and improve predictive capability for its future evolution.**		
Performance Goal 2.1.5.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.5.1: ES-12-10	Demonstrate planned progress in understanding the roles of ocean, atmosphere, land, and ice in the climate system and improving predictive capability for future evolution. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
APG 2.1.5.1: ES-12-11	Achieve mission success criteria for the Ocean Surface Topography Mission (OSTM).	Earth Systematic Missions	Earth Science
Performance Goal 2.1.5.2	***HPPG: Study Earth from space to understand climate change, weather, and human impact on our planet by launching at least two missions by 2015.***		
APG 2.1.5.2: ES-12-12	Launch the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP).	Earth Systematic Missions	Earth Science
Performance Goal 2.1.5.3	***By 2015, launch at least three missions in support of this objective.***		
APG 2.1.5.3: ES-12-13	Complete the ICESat-2 Preliminary Design Review.	Earth System Science Pathfinder	Earth Science
APG 2.1.5.3: ES-12-2	Complete the Orbiting Carbon Observatory-2 (OCO-2) Systems Integration Review.	Earth System Science Pathfinder	Earth Science
Objective 2.1.6	**Characterize the dynamics of Earth's surface and interior and form the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.**		
Performance Goal 2.1.6.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.6.1: ES-12-14	Demonstrate planned progress in characterizing the dynamics of Earth's surface and interior and forming the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Earth Science
Performance Goal 2.1.6.2	***By 2015, launch at least one mission in support of this objective.***		
APG 2.1.6.2: ES-12-7	Complete the Landsat Data Continuity Mission (LDCM) Systems Integration Review.	Earth Systematic Missions	Earth Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.1.7	**Enable the broad use of Earth system science observations and results in decision-making activities for societal benefits.**		
Performance Goal 2.1.7.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.1.7.1: ES-12-15	Advance at least 25 percent of decision-support projects at least one Applications Readiness Level.	Applied Sciences	Earth Science
APG 2.1.7.1: ES-12-16	Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.	Earth Science Research	Earth Science
APG 2.1.7.1: ES-12-17	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.	Earth Science Research	Earth Science
Outcome 2.2	**Understand the Sun and its interactions with Earth and the solar system.**		
Objective 2.2.1	**Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.**		
Performance Goal 2.2.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.1.1: HE-12-1	Demonstrate planned progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics
Performance Goal 2.2.1.2	***By 2015, launch two missions in support of this outcome.***		
APG 2.2.1.2: HE-12-2	Complete the Magnetospheric MultiScale (MMS) Systems Integration Review.	Solar Terrestrial Probes	Heliophysics
APG 2.2.1.2: HE-12-3	Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.	Living with a Star	Heliophysics
Objective 2.2.2	**Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.**		
Performance Goal 2.2.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.2.1: HE-12-4	Demonstrate planned progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 2.2.2.2	***By 2015, launch two missions in support of this outcome.***		
APG 2.2.2.2: HE-12-2	Complete the Magnetospheric MultiScale (MMS) Systems Integration Review.	Solar Terrestrial Probes	Heliophysics
APG 2.2.2.2: HE-12-3	Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.	Living with a Star	Heliophysics
Objective 2.2.3	**Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.**		
Performance Goal 2.2.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.2.3.1: HE-12-5	Demonstrate planned progress in maximizing the safety and productivity of human and robotic explorers by developing the capability to predict the extreme and dynamic conditions in space. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Heliophysics
Performance Goal 2.2.3.2	***By 2017, launch at least two missions in support of this outcome.***		
APG 2.2.3.2: HE-12-3	Complete the Geospace Radiation Belt Storm Probes Launch Readiness Review.	Living with a Star	Heliophysics
Outcome 2.3	**Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.**		
Objective 2.3.1	**Inventory solar system objects and identify the processes active in and among them.**		
Performance Goal 2.3.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.1.1: PS-12-1	Demonstrate planned progress in inventorying solar system objects and identifying the processes active in and among them. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Performance Goal 2.3.1.2	***By 2015, launch at least two missions in support of this outcome.***		
APG 2.3.1.2: PS-12-2	Complete the New Frontiers 3 Preliminary Design Review.	New Frontiers	Planetary Science
APG 2.3.1.2: PS-12-3	Complete the Discovery 12 mission concept studies.	Discovery	Planetary Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.3.2	**Improve understanding of how the Sun's family of planets, satellites, and minor bodies originated and evolved.**		
Performance Goal 2.3.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.2.1: PS-12-4	Demonstrate planned progress in understanding how the Sun's family of planets, satellites, and minor bodies originated and evolved. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
APG 2.3.2.1: PS-12-5	Complete MESSENGER mission success criteria.	Discovery	Planetary Science
Performance Goal 2.3.2.2	***By 2015, launch at least three missions in support of this outcome.***		
APG 2.3.2.2: PS-12-2	Complete the New Frontiers 3 Preliminary Design Review.	New Frontiers	Planetary Science
APG 2.3.2.2: PS-12-6	Complete the Lunar Atmosphere and Dust Environment Explorer (LADEE) Systems Integration Review.	Lunar Quest Program	Planetary Science
Objective 2.3.3	**Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.**		
Performance Goal 2.3.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.3.1 : PS-12-7	Demonstrate planned progress in understanding the processes that determine the history and future of habitability of environments on Mars and other solar system bodies. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Performance Goal 2.3.3.2	***By 2015, launch at least two missions in support of this outcome.***		
APG 2.3.3.2: PS-12-10	Complete the Mars 16 Mission Confirmation Review.	Mars Exploration	Planetary Science
APG 2.3.3.2: PS-12-8	Complete the Mars Science Laboratory (MSL) Launch Readiness Review.	Mars Exploration	Planetary Science
APG 2.3.3.2: PS-12-9	Complete the Mars Atmosphere and Volatile EvolutioN Mission (MAVEN) Systems Integration Review.	Mars Exploration	Planetary Science

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 2.3.4	**Improve understanding of the origin and evolution of Earth's life and biosphere to determine if there is or ever has been life elsewhere in the universe.**		
Performance Goal 2.3.4.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.4.1 : PS-12-11	Demonstrate planned progress in understanding the origin and evolution of life on Earth and throughout the biosphere to determine if there is or ever has been life elsewhere in the universe. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Objective 2.3.5	**Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.**		
Performance Goal 2.3.5.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.3.5.1: PS-12-12	Demonstrate planned progress in identifying and characterizing small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Planetary Science
Performance Goal 2.3.5.2	***Return data for selection of destinations in order to lower risk for human space exploration beyond low Earth orbit.***		
APG 2.3.5.2: PS-12-13	Demonstrate planned progress in characterizing potentially hazardous objects that are possible destinations for future human space exploration.	Multiple Programs	Planetary Science
Outcome 2.4	**Discover how the universe works, explore how it began and evolved, and search for Earth-like planets.**		
Objective 2.4.1	**Improve understanding of the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity.**		
Performance Goal 2.4.1.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.1.1: AS-12-1	Demonstrate planned progress in understanding the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 2.4.1.2	***By 2015, launch at least one mission in support of this outcome.***		
APG 2.4.1.2: AS-12-2	Complete the Nuclear Spectroscopic Telescope Array (NuSTAR) Launch Readiness Review.	Astrophysics Explorer	Astrophysics
Objective 2.4.2	**Improve understanding of the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today.**		
Performance Goal 2.4.2.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.2.1: AS-12-3	Demonstrate planned progress in understanding the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics
Performance Goal 2.4.2.2	***Design and assemble James Webb Space Telescope (JWST).***		
APG 2.4.2.2: JWST-12-1	Begin integration of James Webb Space Telescope (JWST) flight optics into Optical Telescope Element (OTE).	James Webb Space Telescope	James Webb Space Telescope
Performance Goal 2.4.2.3	***Develop and operate an airborne infrared astrophysics observatory.***		
APG 2.4.2.3: AS-12-4	Initiate the Stratospheric Observatory for Infrared Astronomy (SOFIA) Segment 3 Aircraft modifications and upgrades.	Cosmic Origins	Astrophysics
Objective 2.4.3	**Generate a census of extra-solar planets and measure their properties.**		
Performance Goal 2.4.3.1	***Provide national scientific capabilities through necessary skilled researchers and supporting knowledge base.***		
APG 2.4.3.1: AS-12-5	Demonstrate planned progress in generating a census of extra-solar planets and measuring their properties. Progress relative to the objectives in NASA's 2010 Science Plan will be evaluated by external expert review.	Multiple Programs	Astrophysics

Management and Performance

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 3	**Create the innovative new space technologies for our exploration, science, and economic future.**		
Outcome 3.1	**Sponsor early-stage innovation in space technologies in order to improve the future capabilities of NASA, other government agencies, and the aerospace industry.**		
Objective 3.1.1	**Create a pipeline of new low Technology Readiness Levels (TRL) innovative concepts and technologies for future NASA missions and national needs.**		
Performance Goal 3.1.1.1	***Explore revolutionary aerospace concepts, with an initial research phase for preliminary assessment of a broad range of ideas, and a second phase for further development of the most promising concepts.***		
APG 3.1.1.1: ST-12-1	Initiate Phase II studies to further develop two of the most promising prior (FY 2011 and predecessor NASA Institute for Advanced Concepts (NIAC)) Phase I concepts.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.2	***Provide cash prize incentives to non-traditional sources for innovations of interest and value to NASA and the Nation.***		
APG 3.1.1.2: ST-12-2	Conduct at least three Centennial Challenges competitions.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.3	***Establish and maintain a culture of innovation at each of the 10 NASA Centers through the development of new Center ideas and technologies.***		
APG 3.1.1.3: ST-12-3	Twenty innovative projects will be initiated across the NASA Centers.	Crosscutting Space Technology Development	Space Technology
Performance Goal 3.1.1.4	***Increase the proportion of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies successfully infused into NASA programs/projects.***		
APG 3.1.1.4: ST-12-4	At least 25 percent of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase II technology projects awarded between 2007-2011 will be infused into NASA programs and projects.	SBIR and STTR	Space Technology
Performance Goal 3.1.1.5	***Increase the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) Phase III contracts initiated or expanded.***		
APG 3.1.1.5: ST-12-5	At least 40 of the Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies will be advanced to Phase III (received non-SBIR/STTR funding).	SBIR and STTR	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 3.1.1.6	***Accelerate the development of push technologies to support the future space, science and exploration needs of NASA, other government agencies, and the commercial space sector.***		
APG 3.1.1.6: ST-12-6	Complete 100 research plans.	Crosscutting Space Technology Development	Space Technology
Outcome 3.2	**Infuse game changing and crosscutting technologies throughout the Nation's space enterprise to transform the Nation's space mission capabilities.**		
Objective 3.2.1	**Prove the technical feasibility of potentially disruptive new space technologies for future missions.**		
Performance Goal 3.2.1.1	***Transition developed game changing technologies to the technology demonstration programs or directly to Mission Directorates for mission insertion.***		
APG 3.2.1.1: ST-12-7	Initiate five game changing technology projects.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.2	**Spur the development of routine, low-cost access to space through small payloads and satellites.**		
Performance Goal 3.2.2.1	***Mature technologies that enable small satellites to provide game changing capabilities for the government and commercial space sectors.***		
APG 3.2.2.1: ST-12-8	Initiate development of at least two new technologies with game changing potential for small satellites.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.3	**Demonstrate new space technologies and infuse them into future science and exploration small satellite missions and/or commercial use.**		
Performance Goal 3.2.3.1	***Demonstrate small satellite capabilities with game changing and crosscutting potential for the government and commercial space sectors.***		
APG 3.2.3.1: ST-12-9	Initiate at least one new small satellite mission that will demonstrate game changing or crosscutting technologies in space.	Crosscutting Space Technology Development	Space Technology
Objective 3.2.4	**Demonstrate new space technologies and infuse them into missions.**		
Performance Goal 3.2.4.1	***Infuse game changing and crosscutting technologies into future NASA missions through flight or relevant environment demonstrations.***		
APG 3.2.4.1: ST-12-10	Complete preliminary design of at least two system-level technologies for flight or relevant environment demonstration.	Crosscutting Space Technology Development	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 3.2.5	**Provide flight opportunities and relevant environments to demonstrate new space technologies.**		
Performance Goal 3.2.5.1	***Perform sub-orbital, simulated zero-gravity and other space analog flight opportunities to develop and demonstrate emerging ideas and technologies.***		
APG 3.2.5.1: ST-12-11	Select and fly technology payloads from NASA, other government agencies, industry, and academia using flight services procured from at least three commercial reusable suborbital and parabolic platform providers.	Crosscutting Space Technology Development	Space Technology
Outcome 3.3	**Develop and demonstrate the critical technologies that will make NASA's exploration, science, and discovery missions more affordable and more capable.**		
Objective 3.3.1	**Demonstrate in-space operations of robotic assistants working with crew.**		
Performance Goal 3.3.1.1	***Demonstrate robotic technologies that support in-space operations, scientific discovery, and work as assistants with the crew.***		
APG 3.3.1.1: ERD-12-8	Demonstrate Robonaut 2 assisting the crew to perform tasks inside the ISS.	Exploration Technology Development	Space Technology
Objective 3.3.2	**Develop and demonstrate critical technologies for safe and affordable cargo and human space exploration missions beyond low Earth orbit.**		
Performance Goal 3.3.2.1	***Develop advanced spacesuits to improve the ability of astronauts to conduct Extra-Vehicular Activity (EVA) operations in space including assembly and service of in-space systems and exploration of surfaces of the Moon, Mars, near-Earth objects (NEOs), and other small bodies.***		
APG 3.3.2.1: ERD-12-9	Initiate tests of Extra-Vehicular Activity (EVA) Portable Life Support System (PLSS) technologies in a vacuum chamber environment.	Advanced Explorations Systems	Exploration Research and Development
Performance Goal 3.3.2.2	***Develop technologies and mission concepts for demonstrating in-space cryogenic propellant storage and transfer making exploration and science missions more affordable and capable.***		
APG 3.3.2.1: ST-12-12	Test automated fluid couplings for cryogenic propellant transfer to support Cryogenic Propellant Storage And Transfer (CRYOSTAT) systems requirements.	Exploration Technology Development	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 3.4	**Facilitate the transfer of NASA technology and engage in partnerships with other government agencies, industry, and international entities to generate U.S. commercial activity and other public benefits.**		
Objective 3.4.1	**Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and national interests.**		
Performance Goal 3.4.1.1	***Establish 12 technology-related significant partnerships that create value for programs and projects. Track both quantitative dollar value and qualitative benefits to NASA (e.g., reduced volume or mass, improved safety) per year.***		
APG 3.4.1.1: ST-12-13	Establish at least 12 technology-related significant partnerships during FY 2012.	Partnership Development and Strategic Integration	Space Technology
Performance Goal 3.4.1.2	***Complete 30 technology transfer agreements with the commercial and academic community through such mechanisms as licenses, software use agreements, facility use agreements, and Space Act Agreements per year.***		
APG 3.4.1.2: ST-12-14	Complete at least 30 technology transfer agreements during FY 2012.	Partnership Development and Strategic Integration	Space Technology
Performance Goal 3.4.1.3	***Successful application of Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technologies into commercial products or services.***		
APG 3.4.1.3: ST-12-15	Greater than 35 percent of the Phase II Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) technology projects awarded between 2007-2011 will be transferred into commercial products or services.	SBIR and STTR	Space Technology
Performance Goal 3.4.1.4	***Document 40-50 of the most notable examples of successful transfer and commercialization of NASA-derived technology per year and publish in Spinoff annually.***		
APG 3.4.1.4: ST-12-16	Document at least 40 notable technology transfer successes in NASA's Spinoff publication.	Partnership Development and Strategic Integration	Space Technology

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 3.4.1.5	***Document, coordinate, and prioritize Agency-level technology strategic investments to ensure NASA has a balanced portfolio of both near-term NASA mission (pull) technologies and longer-term transformational (push) technologies that benefit both Agency programs and national needs.***		
APG 3.4.1.5: ST-12-17	Ensure that 75 percent of all NASA technology projects are recorded in the portfolio database and are analyzed against the prioritizations in the space technology roadmaps.	Partnership Development and Strategic Integration	Space Technology
Strategic Goal 4	**Advance aeronautics research for societal benefit.**		
Outcome 4.1	**Develop innovative solutions and advanced technologies through a balanced research portfolio to improve current and future air transportation.**		
Objective 4.1.1	**Develop advanced technologies to improve the overall safety of the future air transportation system.**		
Performance Goal 4.1.1.1	***Transfer knowledge to the aviation community to better manage safety in aviation.***		
APG 4.1.1.1: AR-12-1	Develop first generation engine icing performance degradation parametric simulation capability.	Aviation Safety	Aeronautics
APG 4.1.1.1: AR-12-2	Provide static code analysis techniques for certification.	Aviation Safety	Aeronautics
APG 4.1.1.1: AR-12-3	Develop concept of operations for an integrated vehicle health assurance system.	Aviation Safety	Aeronautics
APG 4.1.1.1: AR-12-4	Demonstrate algorithm to predict at least three anomalies in massive datasets.	Aviation Safety	Aeronautics
Objective 4.1.2	**Develop innovative solutions and technologies to meet future capacity and mobility requirements of the Next Generation Air Transportation System (NextGen).**		
Performance Goal 4.1.2.1	***HPPG: Increase efficiency and throughput of aircraft operations during arrival phase of flight.***		
APG 4.1.2.1: AR-12-5	Develop Initial Weather Translation Models.	Airspace Systems	Aeronautics
APG 4.1.2.1: AR-12-6	Demonstrate safe Interval Management Procedures to a Single Airport with dependent parallel runways.	Airspace Systems	Aeronautics
APG 4.1.2.1: AR-12-7	NASA will provide the results of the human-in-the-loop (HITL) simulations and the field trial to the Federal Aviation Administration (FAA) as they are completed, with the final report being provided in September 2012. (HPPG milestone)	Airspace Systems	Aeronautics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 4.1.3	**Develop tools, technologies, and knowledge that enable significantly improved performance and new capabilities for future air vehicles.**		
Performance Goal 4.1.3.1	***Deliver tools, technologies, and knowledge that can be used to more efficiently and effectively design future air vehicles and their components that overcome national performance and capability challenges.***		
APG 4.1.3.1: AR-12-10	Validate the effectiveness of Micro-array Flow Control devices for improving performance and flow quality in low-boom supersonic propulsion inlets.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-12-11	Demonstrate First Generation Integrated Multidisciplinary Simulation Tool for Analysis and Design of Reusable Air-Breathing Launch Vehicles.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-12-8	Characterize gaseous and particulate emissions of hydro treated renewable jet fuel as a potential carbon dioxide (CO2) neutral aviation fuel.	Fundamental Aeronautics	Aeronautics
APG 4.1.3.1: AR-12-9	Demonstrate drag reduction benefits of active flow control for a representative rotorcraft fuselage configuration.	Fundamental Aeronautics	Aeronautics
Outcome 4.2	**Conduct systems-level research on innovative and promising aeronautics concepts and technologies to demonstrate integrated capabilities and benefits in a relevant flight and/or ground environment.**		
Objective 4.2.1	**Develop advanced tools and technologies that reduce the technical risk associated with system-level integration of promising aeronautical concepts.**		
Performance Goal 4.2.1.1	***Reduce technical risk by conducting research at an integrated system-level on promising aeronautical concepts and technologies in a relevant environment.***		
APG 4.2.1.1: AR-12-12	Demonstrate low-weight, damage-tolerant stitched composite structural concept on curved panel subjected to combined tension and internal pressure loads.	Integrated Systems Research	Aeronautics
APG 4.2.1.1: AR-12-13	Develop integrated Human Systems Integration, Communications, and Separation Assurance subproject test concept and Phase 2 test objectives necessary to achieve human-in-the-loop simulation and flight test series milestones supporting the Unmanned Aircraft Systems (UAS) Integration in the National Airspace System (NAS) Project.	Integrated Systems Research	Aeronautics

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Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 5	**Enable program and institutional capabilities to conduct NASA's aeronautics and space activities.**		
Outcome 5.1	**Identify, cultivate, and sustain a diverse workforce and inclusive work environment that is needed to conduct NASA missions.**		
Objective 5.1.1	**Establish and maintain a workforce that possesses state-of-the-art technical and business management competencies.**		
Performance Goal 5.1.1.1	***Define and build the federal workforce skills and competencies needed for the Agency's future directions in technology development and deep space exploration.***		
APG 5.1.1.1: AMO-12-1	Ninety percent of Shuttle workforce is assigned to follow-on work by FY 2012 year-end.	Agency Management	Agency Management and Operations
APG 5.1.1.1: AMO-12-2	Twenty percent or more of annual recruitments will be through the early career hiring initiatives.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.2	***Build skills across all levels of the workforce through Leadership Development Opportunities.***		
APG 5.1.1.2: AMO-12-3	Install an Agency-wide mentoring program that includes an automated system for matching mentors and mentees.	Agency Management	Agency Management and Operations
APG 5.1.1.2: AMO-12-4	Eighty percent of the Agency's leadership training and development programs include "leading through transformation" content.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.3	***Achieve and sustain an effective labor-management dialogue.***		
APG 5.1.1.3: AMO-12-5	Identify and address at least three significant labor-management challenges identified during the year during periodic Agency-led Labor Management Forums.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.4	***Adopt and respond to innovative employee feedback mechanisms.***		
APG 5.1.1.4: AMO-12-6	Seventy-five percent of NASA's primary installations implement improvement initiatives derived from the Federal Employee Viewpoint Survey.	Agency Management	Agency Management and Operations
Performance Goal 5.1.1.5	***Establish and maintain a workplace environment free of illegal discrimination, harassing conduct, and retaliation for Equal Employment Opportunity (EEO) activity and that provides reasonable accommodations to individuals with disabilities.***		
APG 5.1.1.5: AMO-12-7	Complete all FY 2012 actions described in the NASA Model Equal Employment Opportunity (EEO) Agency Plan.	Agency Management	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 5.1.1.6	***Implement an Agency-wide Diversity and Inclusion Framework to develop a more demographically diverse workforce and a more inclusive work environment.***		
APG 5.1.1.6: AMO-12-8	Adopt diversity improvement targets derived from the results of the Agency-wide diversity-inclusion survey and other relevant workforce and U.S. population data.	Agency Management	Agency Management and Operations
Objective 5.1.2	**Provide opportunities and support systems that recruit, retain, and develop undergraduate and graduate students in STEM-related disciplines.**		
Performance Goal 5.1.2.1	***Assure that student participants in NASA higher education projects are representative of the diversity of the Nation.***		
APG 5.1.2.1: ED-12-1	Achieve 40 percent participation of underserved and underrepresented (in race and/or ethnicity) in NASA higher education projects.	STEM Education and Accountability	Education
APG 5.1.2.1: ED-12-2	Achieve 45 percent participation of women in NASA higher education projects.	STEM Education and Accountability	Education
Outcome 5.2	**Ensure vital assets are ready, available, and appropriately sized to conduct NASA's missions.**		
Objective 5.2.1	**Achieve mission success by factoring safety, quality, risk, reliability, and maintainability as integral features of programs, projects, technologies, operations, and facilities.**		
Performance Goal 5.2.1.1	***Through 2015, assure zero fatalities or permanent disabling injuries to the public.***		
APG 5.2.1.1: AMO-12-9	Assure zero fatalities or permanent disabling injuries to the public resulting from NASA activities during the fiscal year.	Safety and Mission Success	Agency Management and Operations
Performance Goal 5.2.1.2	***By 2015, achieve a four percent reduction in the total case rate and lost time rate for the NASA civil service work force.***		
APG 5.2.1.2: AMO-12-10	Reduce Total Case Rate and Lost Time Case Rate by one percent, in accordance with the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.	Safety and Mission Success	Agency Management and Operations
Performance Goal 5.2.1.3	***By 2015, reduce damage to NASA assets by eight percent from the 2010 baseline.***		
APG 5.2.1.3: AMO-12-11	Reduce damage to NASA assets by two percent per fiscal year, based on a five-year running average.	Safety and Mission Success	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 5.2.2	**Provide information technology that advances NASA space and research program results and promotes open dissemination through efficient, innovative, reliable, and responsive services that are appropriately secure and valued by stakeholders and the public.**		
Performance Goal 5.2.2.1	***By 2014, consolidate and centralize the management of information technology (IT) enterprise services for end user services, communications, enterprise applications, enterprise data centers, and web services.***		
APG 5.2.2.1: AMO-12-12	Achieve Initial Operating Capability (IOC) for one Service Office (NASA Enterprise Data Center) and Full Operational Capacity (FOC) for the initial five Service Offices as part of the NASA Information Technology Infrastructure Integration Program (I3P).	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.2	***By 2015, implement a capability to identify and prevent unauthorized intrusions on the NASA institutional and mission networks.***		
APG 5.2.2.2: AMO-12-13	Implement intrusion detection sensors monitored by the NASA Security Operations Center (SOC) on 75 percent of NASA institutional network monitoring sites.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.3	***By 2014, decommission the Agency Administrative mainframe computer.***		
APG 5.2.2.3: AMO-12-14	Migrate or retire all administrative systems from the Agency Administrative mainframe computer.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.4	***By 2015, reduce data center energy consumption by 30 percent.***		
APG 5.2.2.4: AMO-12-15	Reduce the number of NASA data centers by 10 percent.	Agency IT Services (AITS)	Agency Management and Operations
Performance Goal 5.2.2.5	***By 2015, establish at least four innovation laboratories that provide more effective, efficient, and responsive information technology (IT) across NASA in support of the Agency's Mission.***		
APG 5.2.2.5: AMO-12-16	Implement a Communications and Collaboration Lab that conducts five evaluations to assess new approaches for the dissemination of information, and real-time, multi-participant knowledge creation and management.	Agency IT Services (AITS)	Agency Management and Operations

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 5.2.3	**Develop and implement long-range infrastructure plans that address institutional capabilities and critical assets, directly link to mission needs, ensure the leveraging of external capabilities, and provide a framework for Agency infrastructure decision-making.**		
Performance Goal 5.2.3.1	***Consolidate functions and offices to reduce real property need, and use Agency Integrated Master Plan to identify and dispose of excess and aged facilities beyond useful life.***		
APG 5.2.3.1: AMO-12-17	Finalize remaining Center Master Plans into the Agency Integrated Master Plan.	Agency Management	Agency Management and Operations
APG 5.2.3.1: COF-12-1	Initiate facilities demolition process for five significant Agency facilities in addition to demolition processes initiated in FY 2011.	Institutional CoF	Construction of Facilities
Performance Goal 5.2.3.2	***HPPG: Conserve valuable natural resources by reducing NASA's energy and water use.***		
APG 5.2.3.2: ECR-12-1	Reduce energy intensity use annually by three percent from an FY 2003 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
APG 5.2.3.2: ECR-12-2	Reduce potable water use annually by two percent from an FY 2007 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
APG 5.2.3.2: ECR-12-3	Reduce fleet vehicle energy use annually by two percent of petroleum products from an FY 2005 baseline.	Environmental Compliance and Restoration	Environmental Compliance and Restoration
Outcome 5.3	**Ensure the availability to the Nation of NASA-owned, strategically important test capabilities.**		
Objective 5.3.1	**Work with the National Rocket Propulsion Test Alliance to identify NASA, Department of Defense and commercial capabilities and requirements.**		
Performance Goal 5.3.1.1	***Develop and execute the Rocket Propulsion Test (RPT) Master Plan.***		
APG 5.3.1.1: SFS-12-1	Meet Rocket Propulsion Test (RPT) Master Plan requirements for year one.	Rocket Propulsion Test	Space and Flight Support (SFS)
Objective 5.3.2	**Ensure that Aeronautics Test Program (ATP) facilities are available and capable of supporting research, development, test and engineering goals and objectives for NASA and national aerospace programs.**		
Performance Goal 5.3.2.1	***Ensure that testing capabilities are available in order to support the research, development, test, and engineering milestones of NASA and Department of Defense (DoD) programs.***		
APG 5.3.2.1: AR-12-14	Achieve ratings greater than 86 percent for overall quality and timeliness of Aeronautics Test Program (ATP) facility operations.	Aeronautics Test	Aeronautics

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 5.4	**Implement and provide space communications and launch capabilities responsive to existing and future science and space exploration missions.**		
Objective 5.4.1	**Ensure reliable and cost-effective access to space for missions critical to achieving the National Space Policy of the United States of America.**		
Performance Goal 5.4.1.1	***Complete Launch Services Program (LSP) objectives for all NASA-managed expendable launches.***		
APG 5.4.1.1: SFS-12-2	Sustain 100 percent success rate with the successful launch of NASA-managed expendable launches as identified on the Launch Services Flight Planning Board manifest.	Launch Services	Space and Flight Support (SFS)
Performance Goal 5.4.1.2	***Continue utilizing existing contract mechanisms and agreements with emerging launch vehicle providers to gain information for future Launch Service orders and to provide technical exchanges to enhance early launch success.***		
APG 5.4.1.2: SFS-12-3	Incorporate information sharing processes into programmatic policies and incorporate into crew demonstration activities and future crew transportation service contracts.	Launch Services	Space and Flight Support (SFS)
Objective 5.4.2	**Transform the Florida launch and range complex to provide a robust launch and range infrastructure for future users.**		
Performance Goal 5.4.2.1	***By FY 2014, enable future government and commercial launching and testing from the Florida launch and range complex.***		
APG 5.4.2.1: SFS-12-4	Implement FY 2012 milestones within the 21st Century Space Launch Complex (21st CSLC) plan.	21st Century Space Launch Complex	Space and Flight Support (SFS)
Objective 5.4.3	**Build and maintain a scalable, integrated, mission support infrastructure that can readily evolve to accommodate new and changing technologies, while providing integrated, comprehensive, robust, and cost-effective space communications services at order-of-magnitude higher data rates to enable NASA's science and exploration missions.**		
Performance Goal 5.4.3.1	***By 2014, launch two functionally identical Tracking and Data Relay Satellite (TDRS) spacecraft in geosynchronous orbits to replenish the Tracking and Data Relay Satellite System (TDRSS) constellation.***		
APG 5.4.3.1: SFS-12-5	Complete Tracking and Data Relay Satellite (TDRS) K Pre-ship review.	Space Communications and Navigation	Space and Flight Support (SFS)

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Performance Goal 5.4.3.2	***By FY 2016, replace or upgrade obsolete and unsustainable systems of the Tracking and Data Relay Satellite System (TDRSS) Ground Segment at the White Sands Complex (WSC).***		
APG 5.4.3.2: SFS-12-6	Complete the Space Network Ground Segment Sustainment (SGSS) Preliminary Design Review (PDR).	Space Communications and Navigation	Space and Flight Support (SFS)
Performance Goal 5.4.3.3	***By FY 2018, replace aging and obsolete Deep Space Network (DSN) 70-meter antenna at Canberra Deep Space Communications Complex (CDSCC).***		
APG 5.4.3.3: SFS-12-7	Complete Deep Space Station-35 (DSS-35) antenna fabrication at vendor.	Space Communications and Navigation	Space and Flight Support (SFS)
Outcome 5.5	**Establish partnerships, including innovative arrangements, with commercial, international, and other government entities to maximize mission success.**		
Objective 5.5.1	**Facilitate the use of the ISS as a National Laboratory for cooperative research, technology development, and education.**		
Performance Goal 5.5.1.1	***HPPG: Establish an independent non-profit (NPO) organization to enhance the utilization of the ISS as a National Laboratory.***		
APG 5.5.1.1: ISS-12-7	Facilitate non-profit organization (NPO) implementation of its initial grants solicitation process.	International Space Station Program	International Space Station
Objective 5.5.2	**Enhance international and interagency partnerships through increased use of international and interagency coordination mechanisms.**		
Performance Goal 5.5.2.1	***Actively engage and provide leadership in international and interagency forums.***		
APG 5.5.2.1: AMO-12-18	Establish an internal Interagency Partnerships Working Group (IPWG) led by the Office of International and Interagency Relations (OIIR) to improve Agency-wide coordination of interagency partnerships and related interagency working groups.	Agency Management	Agency Management and Operations

FY 2012 Performance Plan

Measure #	Description	Contributing Program (s)	Contributing Theme
Strategic Goal 6	**Share NASA with the public, educators, and students to provide opportunities to participate in our Mission, foster innovation and contribute to a strong national economy.**		
Outcome 6.1	**Improve retention of students in STEM disciplines by providing opportunities and activities along the full length of the education pipeline.**		
Objective 6.1.1	**Provide quality STEM curricular support resources and materials.**		
Performance Goal 6.1.1.1	***Provide educators nationwide with knowledge and tools with which to inspire students in STEM fields.***		
APG 6.1.1.1: ED-12-3	100,000 educators participate in NASA education programs.	STEM Education and Accountability	Education
Objective 6.1.2	**Provide NASA experiences that inspire student interest and achievement in STEM disciplines.**		
Performance Goal 6.1.2.1	***Provide higher education students with authentic NASA mission-based opportunities that build knowledge and skills needed for STEM careers.***		
APG 6.1.2.1: ED-12-4	25,000 undergraduate and graduate students participate in NASA education opportunities.	STEM Education and Accountability	Education
Performance Goal 6.1.2.2	***Provide elementary and secondary students with authentic NASA mission-based opportunities that build STEM knowledge, skills, and career awareness.***		
APG 6.1.2.2: ED-12-5	600,000 elementary and secondary students participate in NASA instructional and enrichment activities.	STEM Education and Accountability	Education
APG 6.1.2.2: ED-12-6	85 percent of elementary and secondary students express interest in STEM careers following their involvement in NASA education programs.	STEM Education and Accountability	Education
Objective 6.1.3	**Assess grant recipient institutions throughout the education pipeline to ensure that grant recipients demonstrate a consistent commitment to civil rights compliance.**		
Performance Goal 6.1.3.1	***Promote equal opportunity compliance and encourage promising practices among NASA grant recipient institutions through a fully-realized program of civil rights compliance reviews, policy guidance, and technical assistance.***		
APG 6.1.3.1: AMO-12-19	Equal opportunity (EO) assessment and technical assistance provided, or onsite compliance assessment performed, on-location at five STEM or STEM-related programs that receive NASA funding.	Agency Management	Agency Management and Operations

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Measure #	Description	Contributing Program (s)	Contributing Theme
Outcome 6.2	**Promote STEM literacy through strategic partnerships with formal and informal organizations.**		
Objective 6.2.1	**Develop NASA's leadership role in national STEM improvement efforts, as demonstrated by provision of meaningful educator professional development and student experiences, adoption of education technologies, and contributions to STEM education policies and strategies.**		
Performance Goal 6.2.1.1	***Provide educator professional development experiences and materials that align to needs and opportunities identified by districts, states, Department of Education, professional organizations, and other stakeholders.***		
APG 6.2.1.1: ED-12-7	5,000 educators use NASA resources in their curricula after participating in NASA professional development.	STEM Education and Accountability	Education
Performance Goal 6.2.1.2	***Provide expertise in the development of STEM education policies and strategies.***		
APG 6.2.1.2: ED-12-8	Provide expertise to support the development of integrated science and engineering standards.	STEM Education and Accountability	Education
Outcome 6.3	**Engage the public in NASA's missions by providing new pathways for participation.**		
Objective 6.3.1	**Extend the reach of participatory engagement across NASA.**		
Performance Goal 6.3.1.1	***By 2015, establish an Agency-wide portfolio of participatory engagement opportunities.***		
APG 6.3.1.1: AMO-12-20	Issue a competitive opportunity to engage the public in NASA's activities.	Agency Management	Agency Management and Operations
Outcome 6.4	**Inform, engage, and inspire the public by sharing NASA's missions, challenges, and results.**		
Objective 6.4.1	**Use strategic partnerships with formal and informal educational organizations to provide NASA content to promote interest in STEM.**		
Performance Goal 6.4.1.1	***Leverage communities of practice to facilitate sharing of NASA successes and challenges with the public.***		
APG 6.4.1.1: ED-12-9	450 museums and science centers across the country actively engage the public in major NASA events.	STEM Education and Accountability	Education

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Measure #	Description	Contributing Program (s)	Contributing Theme
Objective 6.4.2	**Provide clear, accurate, timely, and consistent information that is readily available and suitable for a diverse audience.**		
Performance Goal 6.4.2.1	***Use current and emerging communications technologies to reach increasingly broad audiences.***		
APG 6.4.2.1: AMO-12-21	Evaluate communication tools for impact and establish Agency best practices.	Agency Management	Agency Management and Operations
Objective 6.4.3	**Provide the communications infrastructure to enable NASA's commitment to make government more open, transparent, and participatory.**		
Performance Goal 6.4.3.1	***Make available Agency records through the Freedom of Information (FOIA) and Privacy Act and Open Gov in accordance with federal laws and regulations.***		
APG 6.4.3.1: AMO-12-22	Finalize NASA Freedom of Information Act (FOIA) regulations.	Agency Management	Agency Management and Operations

FY 2012 Performance Plan

Uniform and Efficiency Measures

Measure #	Description
International Space Station Theme	
APG EFF 1.1.1.4: ISS-12-3	Provide 100 percent of planned on-orbit resources (including power, data, crew time, logistics, and accommodations) needed to support research.
APG EFF 1.1.2.1: ISS-12-6	Accomplish a minimum of 90 percent of the on-orbit research objectives as established one month prior to a given increment, as sponsored by NASA, baselined for FY 2012.
Earth Science Theme	
APG EFF 2.1.7.1: ES-12-16	Increase the number of science data products delivered to Earth Observing System Data and Information System (EOSDIS) users.
APG EFF 2.1.7.1: ES-12-17	Maintain a high level of customer satisfaction, as measured by exceeding the most recently available federal government average rating of the Customer Satisfaction Index.
APG EFF: ES-12-20	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: ES-12-21	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: ES-12-22	Peer-review and competitively award at least 90 percent, by budget, of research projects.
APG EFF: ES-12-23	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Space Technology Theme	
APG EFF 3.4.1.5: ST-12-17	Ensure that 75 percent of all NASA technology projects are recorded in the portfolio database and are analyzed against the prioritizations in the space technology roadmaps.
Agency Management and Operations Theme	
APG EFF 5.2.1.2: AMO-12-10	Reduce Total Case Rate and Lost Time Case Rate by one percent, in accordance with the President's Protecting Our Workers and Ensuring Reemployment (POWER) initiative.
APG EFF 5.2.1.3: AMO-12-11	Reduce damage to NASA assets by two percent per fiscal year, based on a five-year running average.
APG EFF: AMO-12-20	Maintain system execution time during the year-end close process at FY 2010 baseline.
Environmental Compliance and Restoration Theme	
APG EFF 5.2.3.2: ECR-12-1	Reduce energy intensity use annually by three percent from an FY 2003 baseline.
APG EFF 5.2.3.2: ECR-12-2	Reduce potable water use annually by two percent from an FY 2007 baseline.
APG EFF 5.2.3.2: ECR-12-3	Reduce fleet vehicle energy use annually by two percent of petroleum products from an FY 2005 baseline.
Aeronautics Theme	
APG EFF: AR-12-16	Deliver at least 86 percent of on-time availability for operations and research facilities.
Astrophysics Theme	
APG EFF: AS-12-6	Complete all development projects within 110 percent of the cost and schedule baseline.

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Uniform and Efficiency Measures

Measure #	Description
APG EFF: AS-12-7	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: AS-12-8	Peer-review and competitively award at least 95 percent, by budget, of research projects.
APG EFF: AS-12-9	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Heliophysics Theme	
APG EFF: HE-12-6	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: HE-12-7	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: HE-12-8	Peer-review and competitively award at least 90 percent, by budget, of research projects.
APG EFF: HE-12-9	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.
Planetary Science Theme	
APG EFF: PS-12-14	Complete all development projects within 110 percent of the cost and schedule baseline.
APG EFF: PS-12-15	Deliver at least 90 percent of scheduled operating hours for all operations and research facilities.
APG EFF: PS-12-16	Peer-review and competitively award at least 95 percent, by budget, of research projects.
APG EFF: PS-12-17	Reduce time within which 80 percent of NASA Research Announcement (NRA) grants are awarded, from proposal due date to selection, by four percent per year, with a goal of 180 days.

2011 Strategic Plan Objectives		FY 2010	FY 2009	FY 2008	FY 2007
1.1.1	Maintain resources (on-orbit and on the ground) to operate and utilize the ISS.	2.2 Green	2.2 Green	2.2 Green	2.2 Green
1.1.2	Advance engineering, technology, and research capabilities on the ISS.	2.1 Green	2.1 Green	2.1 Green	2.1 Green
		2.3 Green	2.3 Green	2.3 Green	None
1.2.1	Enable the commercial sector to provide cargo and crew services to the International Space Station (ISS).	5.2 Yellow	5.2 Green	5.2 Green	5.2 Green
1.3.1	Execute development of an integrated architecture to conduct human space exploration missions beyond low Earth orbit.	6.4 White	6.5 Green	6.5 Green	None
1.3.2	Develop a robust biomedical research portfolio to mitigate space human health risks.	2.3 Green	2.3 Green	2.3 Green	None
1.3.3	Identify hazards, opportunities and potential destinations, to support future safe and successful human space exploration missions.	3B.3 Green	3B.3 Green	3B.3 Green	3B.3 Green
		3C.3 Green	3C.3 Green	3C.3 Green	3C.3 Green
		3C.4 Green	3C.4 Green	3C.4 Green	3C.4 Green
		6.4 White	6.5 Green	6.5 Green	None
2.1.1	Improve understanding of and improve the predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.	3A.1 Green	3A.1 Green	3A.1 Green	3A.1 Green
2.1.2	Enable improved predictive capability for weather and extreme weather events.	3A.2 Green	3A.2 Green	3A.2 Green	3A.2 Green
2.1.3	Quantify, understand, and predict changes in Earth's ecosystems and biogeochemical cycles, including the global carbon cycle, land cover, and biodiversity.	3A.3 Green	3A.3 Green	3A.3 Green	3A.3 Green
2.1.4	Quantify the key reservoirs and fluxes in the global water cycle and assess water cycle change and water quality.	3A.4 Green	3A.4 Green	3A.4 Green	3A.4 Green
2.1.5	Improve understanding of the roles of the ocean, atmosphere, land and ice in the climate system and improve predictive capability for its future evolution.	3A.5 Green	3A.5 Green	3A.5 Yellow	3A.5 Yellow
2.1.6	Characterize the dynamics of Earth's surface and interior and form the scientific basis for the assessment and mitigation of natural hazards and response to rare and extreme events.	3A.6 Green	3A.6 Green	3A.6 Green	3A.6 Green
		3A.2 Green	3A.2 Green	3A.2 Green	3A.2 Green
2.1.7	Enable the broad use of Earth system science observations and results in decision-making activities for societal benefits.	3A.7 Green	3A.7 Green	3A.7 Green	3A.7 Green

2011 Strategic Plan Objectives		FY 2010	FY 2009	FY 2008	FY 2007
2.2.1	Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.	3B.1 Green	3B.1 Green	3B.1 Green	3B.1 Green
2.2.2	Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.	3B.2 Green	3B.2 Green	3B.2 Green	3B.2 Green
2.2.3	Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.	3B.3 Green	3B.3 Green	3B.3 Green	3B.3 Green
2.3.1	Inventory solar system objects and identify the processes active in and among them.	3C.2 Green	3C.2 Green	3C.2 Green	3C.2 Green
2.3.2	Improve understanding of how the Sun's family of planets, satellites, and minor bodies originated and evolved.	3C.1 Green	3C.1 Green	3C.1 Green	3C.1 Green
2.3.3	Improve understanding of the processes that determine the history and future of habitability of environments on Mars and other solar system bodies.	3C.3 Green	3C.3 Green	3C.3 Green	3C.3 Green
2.3.4	Improve understanding of the origin and evolution of Earth's life and biosphere to determine if there is or ever has been life elsewhere in the universe.	3C.2Green	3C.2Green	3C.2Green	3C.2Green
2.3.5	Identify and characterize small bodies and the properties of planetary environments that pose a threat to terrestrial life or exploration or provide potentially exploitable resources.	3B.3 Green	3B.3 Green	3B.3 Green	3B.3 Green
		3C.4 Green	3C.4 Green	3C.4 Green	3C.4 Green
2.4.1	Improve understanding of the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter, and gravity.	3D.1 Green	3D.1 Green	3D.1 Green	3D.1 Green
2.4.2	Improve understanding of the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today.	3D.2 Green	3D.2 Green	3D.2 Green	3D.2 Green
2.4.3	Generate a census of extra-solar planets and measure their properties.	3D.4 Green	3D.4 Green	3D.4 Green	3D.4 Yellow
3.1.1	Create a pipeline of new low Technology Readiness Levels (TRL) innovative concepts and technologies for future NASA missions and national needs.	None	None	None	None
3.2.1	Prove the technical feasibility of potentially disruptive new space technologies for future missions.	None	None	None	None
3.2.2	Spur the development of routine, low-cost access to space through small payloads and satellites.	None	None	None	None
3.2.3	Demonstrate new space technologies and infuse them into future science and exploration small satellite missions and/or commercial use.	None	None	None	None
3.2.4	Demonstrate new space technologies and infuse them into missions.	5.3 Green	None	5.3 Green	5.3 Green

2011 Strategic Plan Objectives		FY 2010	FY 2009	FY 2008	FY 2007
3.2.5	Provide flight opportunities and relevant environments to demonstrate new space technologies.	5.1 Green	5.1 Green	5.1 Green	5.1 Green
3.3.1	Demonstrate in-space operations of robotic assistants working with crew.	None	None	None	None
3.3.2	Develop and demonstrate critical technologies for safe and affordable cargo and human space exploration missions beyond low Earth orbit.	6.2 Green	6.2 Green	6.2 Green	6.2 Green
		6.3 Green	6.3 Green	6.3 Green	None
3.4.1	Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects and national interests.	5.3 Green	None	5.3 Green	5.3 Green
4.1.1	Develop advanced technologies to improve the overall safety of the future air transportation system.	3E.1 Green	3E.1 Green	3E.1 Green	3E.1 Green
4.1.2	Develop innovative solutions and technologies to meet future capacity and mobility requirements of the Next Generation Air Transportation System (NextGen).	3E.2 Green	3E.2 Green	3E.2 Green	3E.2 Green
4.1.3	Develop tools, technologies, and knowledge that enable significantly improved performance and new capabilities for future air vehicles.	3E.3 Green	3E.3 Green	3E.3 Green	3E.3 Green
4.2.1	Develop advanced tools and technologies that reduce the technical risk associated with system-level integration of promising aeronautical concepts.	3E.5 Yellow	3E.5 Yellow	3E.5 Yellow	3E.5 Yellow
5.1.1	Establish and maintain a workforce that possesses state-of-the-art technical and business management competencies.	AS.2 Green	None	None	None
5.1.2	Provide opportunities and support systems that recruit, retain, and develop undergraduate and graduate students in STEM-related disciplines.	ED.1 Green	ED.1 Green	ED.1 Green	ED.1 Green
		ED.2 Green	ED.2 Green	ED.2 Green	None
5.2.1	Achieve mission success by factoring safety, quality, risk, reliability and maintainability as integral features of programs, projects, technologies, operations, and facilities.	AS.4 Green	None	None	None
5.2.2	Provide information technology that advances NASA space and research program results and promotes open dissemination through efficient, innovative, reliable, and responsive services that are appropriately secure and valued by stakeholders and the public.	AS.1 Green	None	None	None
5.2.3	Develop and implement long-range infrastructure plans that address institutional capabilities and critical assets, directly link to mission needs, ensure the leveraging of external capabilities, and provide a framework for Agency infrastructure decision-making.	AS.3 Green	None	None	None
5.3.1	Work with the National Rocket Propulsion Test Alliance to identify NASA, Department of Defense	AS.5 Green	6.4 Green	6.4 Green	6.4 Green

2011 Strategic Plan Objectives		FY 2010	FY 2009	FY 2008	FY 2007
	and commercial capabilities and requirements.	5.1 Green	5.1 Green	5.1 Green	5.1 Green
5.3.2	Ensure that Aeronautics Test Program (ATP) facilities are available and capable of supporting research, development, test and evaluation goals and objectives for NASA and national aerospace programs.	3E.4 Green	3E.4 Green	3E.4 Green	3E.4 Green
5.4.1	Ensure reliable and cost-effective access to space for missions critical to achieving the National Space Policy of the United States of America.	AS.5 Green	6.4 Green	6.4 Green	6.4 Green
		5.1 Green	5.1 Green	5.1 Green	5.1 Green
5.4.2	Transform the Florida launch and range complex to provide a robust launch and range infrastructure for future users.	AS.5 Green	6.4 Green	6.4 Green	6.4 Green
5.4.3	Build and maintain a scalable, integrated, mission support infrastructure that can readily evolve to accommodate new and changing technologies, while providing integrated, comprehensive, robust, and cost-effective space communications services at order-of-magnitude higher data rates to enable NASA's science and exploration missions.	AS.5 Green	6.4 Green	6.4 Green	6.4 Green
5.5.1	Facilitate the use of the ISS as a National Laboratory for cooperative research, technology development, and education.	None	None	None	None
5.5.2	Enhance international and interagency partnerships through increased use of international and interagency coordination mechanisms.	6.4 White	6.5 Green	6.5 Green	None
6.1.1	Provide quality STEM curricular support resources and materials.	ED.2 Green	ED.2 Green	ED.2 Green	None
6.1.2	Provide NASA experiences that inspire student interest and achievement in STEM disciplines.	ED.2 Green	ED.2 Green	ED.2 Green	None
6.1.3	Assess grant recipient institutions throughout the education pipeline to ensure that grant recipients demonstrate a consistent commitment to civil rights compliance.	ED.1 Green	ED.1 Green	ED.1 Green	ED.1 Green
6.2.1	Develop NASA's leadership role in national STEM improvement efforts, as demonstrated by provision of meaningful educator professional development and student experiences, adoption of education technologies, and contributions to STEM education policies and strategies.	ED.1 Green	ED.1 Green	ED.1 Green	ED.1 Green
6.3.1	Extend the reach of participatory engagement across NASA.	None	None	None	None
6.4.1	Use strategic partnerships with formal and informal educational organizations to provide NASA content to promote interest in STEM.	ED.3 Green	ED.3 Green	ED.3 Green	ED.3 Green
6.4.2	Provide clear, accurate, timely, and consistent information that is readily available and suitable for a diverse audience.	None	None	None	None